PRESS OF
STETTINER, LAMBERT & CO.,
22, 24 & 26 READE ST.,
NEW YORK.

PREFACE.

THE aim of the authors has been to present, as far as possible, an unbiassed estimate of the value of electricity in the treatment of the diseases peculiar to women. The agent is considered, not from the standpoint of a specific, but as a valuable adjuvant to routine therapeutic methods. Whatever positive assertion may be found in the work is the outcome of ample and prolonged study and experience. The hope is expressed that one result of the labor herein expended may be the more general resort to an agent too long neglected and yet of inestimable value.

The majority of the drawings for the woodcuts were specially prepared by Dr. J. H. Gunning.

The thanks of the authors are extended to Dr. W. J. Morton, of this city, for the exposition he furnished of the use of the static induced current.

NEW YORK, April, 1891.

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PRACTICAL TREATISE

ON

ELECTRICITY IN GYNÆCOLOGY.

CHAPTER I.

GENERAL CONSIDERATIONS AND DESCRIPTION OF APPARATUS.

SINCE the days of the visionary Pliny, who recommended the application of the shock of an electrical eel for the cure of rheumatism and allied disorders, electricity has been developed in one way and another and applied to various diseased conditions; but unfortunately, few records were kept of its application and effects, and those that were only went to show how careless were the observers and how uncertain their results. It was not until the year 1791 that the form of electricity now used became known, when an Italian anatomist named Galvani discovered by accident, after having hung some dead frogs upon an iron balcony by means of copper hooks, that the legs of the suspended frogs twitched whenever they came in contact with the iron of the balcony. Galvani at once perceived that these movements must be due to the influence of electricity; but at first he thought that the electricity was an vital

flow from the muscles and nerves of the frogs, and that the iron and the copper had nothing to do with the effects. Professor Volta, of Como, a short time afterward repeated the experiment of Galvani, but arrived at a different opinion. Volta thought that the nerves and muscles of the frogs had nothing to do with the cause, but were influenced by the metals. This he subsequently found was true by simply laying a small plate of zinc upon a similar plate of copper, with a piece of moistened paper between, and proved that the electrical action was the result of the contact of the surfaces of copper and zinc with the moisture in the paper. For some time each of these celebrated men energetically advanced his own view, so that quite a controversy resulted; but in the end the names of both of these great men came to be connected with the new electrical action, so that it is now spoken of indifferently either as galvanic or as voltaic electricity.

It is only within a few years that we have had anything to use that was dignified enough to be called apparatus for generating and applying electricity; and even after we had fair instruments, their use seemed to fall into the hands of those who resorted to it more for the influence upon the minds of the populace, in consequence of its subtle character, than from any peculiar virtue as a therapeutic agent. In consequence of this uncertain and varied experience, electricity has an influence that the medical profession has been very slow to acknowledge in order to place it in the list of therapeutic agents. However, at last it is recognized, and now and again one is found who, after careful observation, can say: "It is a potent agent." A knowledge of this power must be had, however, before a practical and effectual application of it can be made. Follow with this knowledge care as to detail and selection of conditions, as one would do in prescribing any agent, and we have something that can be relied upon with more certainty than any other agent used in medicine. Not until quite recently has electri-

city been used in the treatment of the diseases of women, and then only after a spasmodic fashion, so to speak, and only by a few gynæcologists; the majority not resorting to it at all, largely on the score of the preconceived notion that it was not of much benefit. A glance at any one of the standard treatises on the diseases of women proves how little the worth of this agent has been appreciated, for where reference is made to it at all it is largely for the purpose of summarily dismissing it in favor of other therapeutic methods apparently more active and necessitating the expenditure of less time. Doubtless, also, many gynæcologists have been deterred from the use of electricity owing to the belief that its application necessitated a thorough knowledge of the physics of the agent, and for this study they have neither had the time nor the inclination. We believe, however, that, given a knowledge of the first principles of electrical phenomena, the practitioner is in a position to use the agent intelligently and to obtain good results, although we would not be understood as underestimating the value of closer study in leading to more scientific application.

French observers have contributed much of value to the subject of the electro-therapeutics of the female sexual organs. Tripier has intelligently worked in this direction, and in particular Apostoli, of Paris, to whom, indeed, belongs much of the credit for laying the foundation of what may be termed with justice new methods of applying electricity to the female sexual organs—methods which have proved valuable adjuncts to our routine measures of treatment of many of the inflammatory and non-inflammatory diseases of women. German and English writers on gynæcology are as yet content to leave electricity largely unnoticed, but in this country numerous observers are beginning to report their results, and many a quiet worker is satisfying himself that there is value in what has been so long neglected; and as days pass experience strengthens the belief that the scientific use of electricity does curtail to a

considerable extent the sphere of usefulness of the time-honored intra-uterine applicator and abdominal section in certain inflammatory affections of the pelvic organs.

In order to attain this end, or even to approximate it, it is essential that the gynæcologist shall approach the study of electricity by a far different route from that followed by the neurologist. The latter resorts to electricity for diagnostic and for prognostic as well as for therapeutic purposes. He deals mainly with the effect of the agent on nerves and with the reaction of muscle. In his hands the fluid is ordinarily disseminated over wide tracts and surfaces. His electrical tests must be delicate, even as is the tissue with which he is chiefly occupied. He must work indirectly, so to speak, in order to reach the organs he would treat, and he must above all avoid strong currents in the instances in which the relatively sound nerve tissue is at all implicated. The gynæcologist, on the other hand, does not resort to electricity for the formation of his diagnosis. It is not, with him, a question of the determination of nerve force or of muscle reaction. The organs which he aims at subjecting to the electric current are closely grouped together in the pelvis, and it is here that the current is localized. He deals chiefly with perverted local nutrition, with local congestion or its consequences. His knowledge, hence, of the physics of electricity need not be so exhaustive as that of the neurologist. Sufficient for him if he knows the peculiar properties of the forms of electricity at his disposal, if he constantly bears in mind the different action of the poles; and then, having made his diagnosis, all that is necessary is the intelligent application of the special property which in the given case seems called for. In short, if he wishes to stimulate, to congest, he must know which current and which pole will do this; and similarly where he aims at sedation, absorption, cauterization, or local anæsthesiation.

Although we are simply on the verge of the development of a new era in the application of electricity to the

diseases of women, and although the possibilities in this direction cannot as yet be distinctly formulated, still the elementary principles on which this application depends are established, and the aim in the following pages is to tersely state these principles and to point out their application to the diseases of women. Knowledge of these principles is essential in order that electricity, when it is used at all, may be used with proper understanding, and not blindly and with disappointment as has been the case in the past, and is still largely so to-day in the hands of many who occasionally endeavor to reinforce time-honored routine methods by electricity.

The contributions to the special electro-therapeutics of the diseases of women are largely scattered in medical journals and in special monographs. While endeavoring to do justice to all, it is but fair to state that in the elaboration of these pages we have in particular utilized the writings of Apostoli, of Paris, and of Engelmann, of St. Louis, who may fairly claim to be the pioneers in the direction of systematizing the rational use of electricity in the diseases of women, and who, above all, teach us the extent to which it is justifiable to utilize the incalculable power of the agent when localized in the pelvis, and yet not inflict damage on our patients. Our purpose, then, is to gather our knowledge within a convenient compass, stating such deductions as appear at present justifiable, without attempt at dogmatism; for the time is hardly ripe as yet for positive statement, except in connection with certain conditions, and enthusiasm must still be greatly tempered. The obtainable results are sometimes, true enough, little short of marvellous; but again, as yet, they are often disappointing.

It must be apparent to every gynæcologist, and to the general practitioner in the habit of treating the diseases of the female pelvic organs, that our routine methods are often slow in action, are frequently nugatory as regards cure, and, exceptionally true enough where requisite precautions are taken, carry with them considerable risk to

the patient. What we seek is an adjuvant method which will yield speedier results and more permanent, if not always lasting, ones; and the wonder is that, in view of the favorable data derivable from a study of what electricity accomplishes in other departments of medicine, this agent has not, until quite recent date, begun to be systematically used in gynæcology. It improves nutrition elsewhere, it stimulates, it allays pain, it causes absorption in other regions of the body; and hence it surely would not be irrational to claim these same properties for it when applied to the pelvic organs, even if the experience of as yet only a limited number of observers had not amply proved the vast superiority of this agent alone or when associated with routine methods, over these methods apart from resort to electricity. The teachings of Tripier, Apostoli, Engelmann, and others are gradually gaining acceptance, and the day is not far distant when electricity will become a very prominent factor for the relief and the cure of morbid changes in the female sexual organs. A vast advance has already been made towards the attainment of more general recognition of the value of this agent in routine gynæcological practice, since it has been proved that its intelligent and satisfactory use requires scarcely more time than many of our routine methods, for thereby an often-expressed objection has been overthrown. Assuming, then—and in this we are to-day justified—that electricity, as applied to the female sexual organs, is safe, easy of application, painless practically, and often curative, its general acceptance can no longer be deferred. Every gynæcologist must learn how to use the agent in accordance with the developing methods of the present, if he would not be left far behind in the race for successful results.

The varieties of electricity of value in the routine treatment of the diseases of the female genital organs are the galvanic, the faradic, and the static; and these varieties, with the essential apparatus, we will describe in turn, with sufficient explicitness, we trust, to enable

the busy practitioner, though unfamiliar with electrical appliances and properties, to understandingly utilize them in his practice. For exhaustive detail the reader is referred to works which treat of the physics of the subject.

The gynæcologist should possess the following apparatus: A galvanic battery, a milliampèremeter, a current regulator, a faradic battery having two or three changeable coils, a set of electrodes for external and internal use—particularly internal—and possibly a static machine.

GALVANISM.

Galvanism may be defined as a real but invisible energy, displaying itself in a current form of mighty power evolved principally during the separation or the decomposing of the molecules of such substances as metals by chemical influences. Among the principal are zinc, copper, platinum, and added to this list is carbon, a peculiar deposit formed around the joints of gas retorts, such as are used in making the common illuminating gas from coal. If two plates, say zinc and copper, or zinc and carbon—the former used nearly universally now for batteries—be fastened together with some substance that cannot convey the current between them, and be placed in a jar of any sort that is partially filled with water made acid by the addition of sulphuric acid, a peculiar excitement is produced upon the elements, and electricity is liberated and passes along the wire back to the cell, guided by the conducting medium of the wire.

In explaining the terms conductor and non-conductor, we distinguish the two classes by saying that a conductor is any substance of such low resistance that it can be used practically for the transmission of electricity, and a non-conductor is any substance of such high resistance that it can be used to prevent the transfer. It is a singular fact that the substances that are best for the reception and transmission of heat are the best materials for use as conductors of the electric current, as a metallic

surface or wire. Electricity seems to flow along this wire in much the same way as water travels through a pipe.

Poles of a Galvanic Battery.—Great confusion exists in the minds of many persons as to the use of the terms positive and negative elements of a battery and the positive and negative poles. This can be very easily understood by bearing in mind that the term *element* is given to the substance of which the plate is made that is used in the cell, and, resting in the fluid, induces the excit-

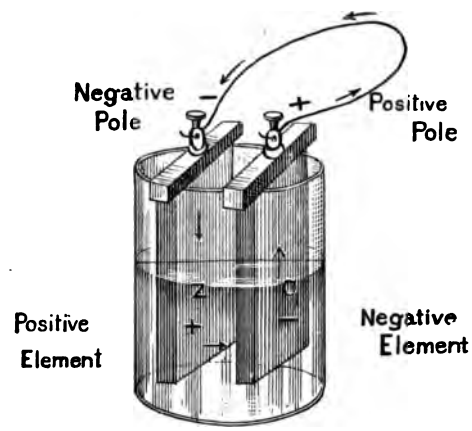


FIG. 1.—Representing the Poles and Elements.

ing and chemical action by which the molecules of the plate are changed, thereby liberating the energy we call electricity.

The term *pole* is applied to that portion of the element that is outside the cell and above the fluid, which becomes the medium for the transmission of the current. The word positive is understood to mean that from which the energy comes (a better term would be anode), and for which the algebraic sign of plus (+) is used; while the term negative indicates that substance which the current enters (or cathode), for which the algebraic sign of minus (−) stands. Hence we see that an element is

both positive and negative. That which is positive as an element is negative as a pole, and *vice versa*. The accompanying figure will illustrate it fully.

Let it be clearly understood that the terms positive and negative do not mean different kinds of electricity, but are relative terms, used for convenience to designate different degrees of electric potential or power.

Electric Potential.—Difference of potential is a comparatively new expression in scientific language, but one of great importance, and a term we often apply to electrified bodies; but it requires explanation. Potential, in the physical sense, is the power to do work. We know that the force of gravity gives velocity to a falling body, and the body acquires power of motion; but when a body is raised from the floor to the table it acquires power of position, not of motion, because it has the power of falling to the floor and so doing a certain amount of mechanical work. How are we to define the power that exists in a ball on a table? It has a potency or power of doing work. Let us take a wooden rod about twenty inches long and half an inch in diameter, with the ends terminating in balls, balanced in the centre on a pivot pin stuck in the cork of a bottle, and made to revolve rapidly by the force of attraction or repulsion following any electrified body held near it, as a piece of sealing wax or glass rod; or attach one end of the rod to a spring that has a resistance corresponding to two ounces' weight, and make fast the other end of the spring to a stand or the wall. Now suppose the electrical power of the sealing wax was just sufficient, if expended without loss, to move the rod one foot, and in so doing to overcome the influence of the spring representing the resistance by two ounces, or one-eighth of a pound. That would be the potential or power of attraction of one-eighth of a pound. Repulsion would produce the same results in this case as attraction. To distinguish between electricity and electric potential we must bear in mind that electricity repre-

sents the power itself, while potential represents certain relations between the energy and matter. Hence is derived the following definition: Electric potential is the power which a body possesses to accomplish work by virtue of the electricity (Atkinson).

Combinations of zinc and copper, or platinum and carbon, are called the *elements* of a battery. When properly arranged, they should be fastened together side by side in pairs, in such a manner as to be completely separated, the one from the other, by a piece of wood, or, better still, by a piece of hard rubber, allowing about one-half inch space between the elements, thus keeping them from touching each other and preventing a current being established between the metals forming the elements. When thus arranged, place the pair of elements (zinc and platinum) into a jar containing acidulated water, made by adding sulphuric acid to the water in the proportion of one part sulphuric acid to nine parts of water, being very careful in the mixing that the acid be slowly poured into the water, and not *vice versa*. When zinc and carbon form the elements, this pair may be placed in a saturated solution of sal-ammoniac—that is, about four ounces to a pint, the solution now generally used in the Axo, Leclanché, and Law cells. When the elements are thus placed in the fluid, with the ends of the metals above the water (H_2O)—that is, a compound of hydrogen and oxygen—if they be connected by a copper wire a peculiar effect is produced, the surface of the carbon or platinum soon becoming completely covered with little bubbles formed of hydrogen gas, that increase in size until they become detached and escape through the fluid into the air, presenting the appearance of heating water, while the fluid around the zinc remains quiet and undisturbed. This peculiar activity is brought about by the changes that are taking place between the fluid and the metals. The zinc plate, being softer, is more easily attacked by the acid, and, having a peculiar affinity for oxygen, decomposes the water in immediate contact with

the zinc, producing thereby a change also in the zinc, making it an oxide of zinc. This oxide formed on the surface of the zinc is dissolved off by the action of the acid in the solution, producing a sulphate that is very soluble in water and leaves a clean surface of zinc. This surface is again acted upon as before, and again becomes soluble, and the hydrogen liberated goes to the carbon as before. This peculiar action will continue as long as there is any portion of zinc to act upon, or ability of the water to dissolve the sulphate formed on the zinc. This is not all. Not only has a new compound been formed and the water decomposed, but during this action the invisible energy called electricity has been induced and commences its motion from the zinc plate, passing through the liquid to the carbon plate, thence up the carbon to the copper wire, along this wire back to the zinc plate, thus making a complete circuit. When the elements are thus arranged, or when they become so by accident (as when a wire becomes loose from a pole and touches another pole in order to make a complete circuit, or when through carelessness in leaving the metallic points of the applying cords or electrodes in contact after an application of the current), it is known as being "short-circuited." To make it even more clear, batteries are always short-circuited when there is no resisting substance (*i.e.*, as a poor conductor) between the wire and pole of the battery.

Negative and Positive Poles and Negative and Positive Elements.—Great perplexity exists in the minds of many persons as to the use of these terms. It can, however, be very easily understood by keeping in mind that the term element, as heretofore described, is given to the substance of which the plate is made, and *rests in the fluid* within the jar. One of these elements is readily affected than the other, and when connected together the current starts from the affected called the positive element, towards the fected (carbon), called the negative elemer

pole, or, as Faraday wants to call them, the electrodes, are the paths or ways of the electricity from the elements. He gave to the one giving out the electricity the prefix syllable *an*, making it the anode, or positive pole; and to the pole receiving the return current the prefix *cath*, making it the cathode, or negative pole. Thus we see the positive element is the negative pole, or the cathode; the negative element is the positive pole, or anode.

Fig. 1 illustrates the plan of circuit and the elements and poles.

Having the elements and the jar, the two form, when

FIG. 2.—AXO Porous Cup.

put together, a part of electrical apparatus called a cell (*vide* Fig. 1).

Cells.—These vary markedly, from the size of a thimble to a jar holding a gallon or two of fluid, with size of elements in proportion. A "cell is a cell," whether it be large or small, varying little in the amount of power given, but markedly in the enduring or lasting ability. This difference may be roughly illustrated by reference to a steam boiler. If two boilers be taken for illustration, the one two feet by four feet, another four feet by eight feet, each boiler holding proportionately the same quantity of water and placed under the same degree of heat, each would yield the same proportional amount of power

upon a machine, but the larger would give power much longer in consequence of the larger extent of surface and capacity. So with the galvanic cell. The wear and tear on a cell, great or small, is the same, but the difficulty that the electrical energy has in making its way from one element through the fluid to another in a small cell soon tires out the energy, and much of the force is lost; this is caused by what is known as

Internal Resistance.—There are two resistances in a battery—the internal and external. The first is the resistance in the fluid, already mentioned, and the external resistance is that which is met with in the wires, etc., used to connect the elements outside the fluid.

Current.—Now the cell is complete, we shall show the phenomena of the energy liberated from it, and, for want of a better one, shall use the term current; that will impress the mind with something that flows. The current is a flow, so to speak, of electricity from its source through any connecting medium back to the element from which it started, in a continuous, unbroken current. The properties of this current are very different from that furnished by a faradic battery. In the selection of cells for a galvanic battery it is preferable to have large ones. They will do more work, last longer, and give better satisfaction. At any rate, the cells must be of uniform size. If two sizes of cells be used, the smaller one will bring the power of a larger one down to its level, so it will amount only to the influence of small cells. And it must also be borne in mind that the cells must contain the same elements or be of the same construction—that is to say, a cell having elements of zinc and platinum must not be in the series of zinc and carbon cells.

There are two qualities of the electric current used in therapeutics:

QUANTITY AND INTENSITY.

Quantity.—The arrangement for this property of electricity is made by connecting the elements of a cell or a

number of cells, already described, in such a way that they shall act as one large battery. This is done by connecting all the zincs together and all the carbons together, thus presenting, as it were, a large surface of each metal to be acted upon by the exciting fluid in the cell. The use made of the current of quantity is for lighting and cautery purposes, and has no value further as a therapeutic agent—that is, it cannot be used for applications of the electric current to disease. The cells

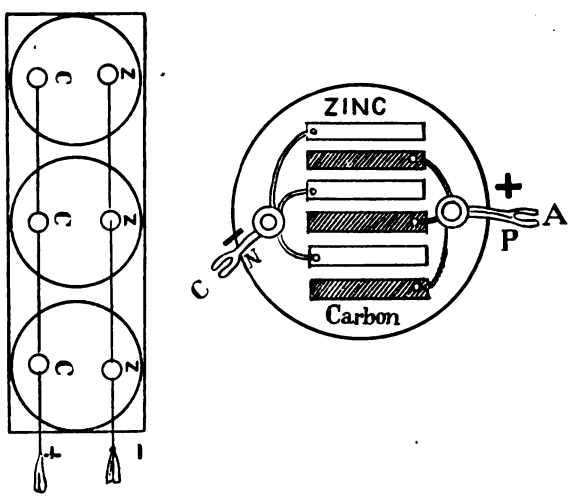


FIG. 3.—Quantity Currents.

for quantity current should be constructed for the purpose, as the cells heretofore described will not do. The accompanying figure will show how the cells are to be connected for the current of quantity.

A full description of this battery will be given under its proper head later on when its uses are described. In this arrangement of cells it matters but little about the poles, so far as the cautery is concerned; the poles are important only in the use of the electrical current when applied to the arts, as in electro-plating.

Intensity.—This form of the electric current is the one

used for all therapeutic applications, whether special or general; consequently the arrangement of the cells must be entirely different from quantity when it is desired to use it for this purpose. The idea of intensity is to so arrange the cells that a greater power may be had from a cell in overcoming many resistances in various forms; consequently they must be so arranged that one will assist the other. To do this it is necessary for the current to pass through each cell that forms the battery, back to its source. This is done by connecting each dissimilar element—as a zinc with a carbon—throughout the entire series, as shown in the accompanying figure.

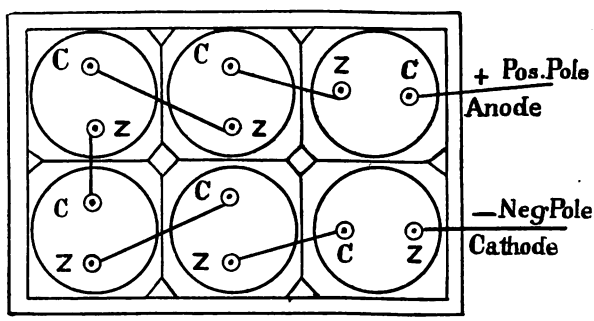


FIG. 4.—Arrangement for Intensity.

This is the plan of arranging the cells in all galvanic batteries, either portable or stationary, for the application of what is known as galvanic electricity to the body. This current of intensity is the current used for all applications, including electrolysis, and is the prime factor in the development of the faradic current.

It is not *per se* a very essential matter as to what special form or make of galvanic battery the gynæcologist possesses; this is a matter which will depend on the taste and the means of the individual. It is, however, of prime importance to own a battery containing an ample number of elements for routine purposes, and it is wise to select a cell which will require the least possible attention. The batteries which we figure are those with which we

are personally familiar, and the implication is not that they are superior to those of other manufacturers. It is desirable to have at least thirty-six to forty cells at one's command. Individual taste may be consulted as to whether the battery shall be portable or stationary, although where electricity is used in routine daily practice it is, for obvious reasons, advisable to possess both forms.

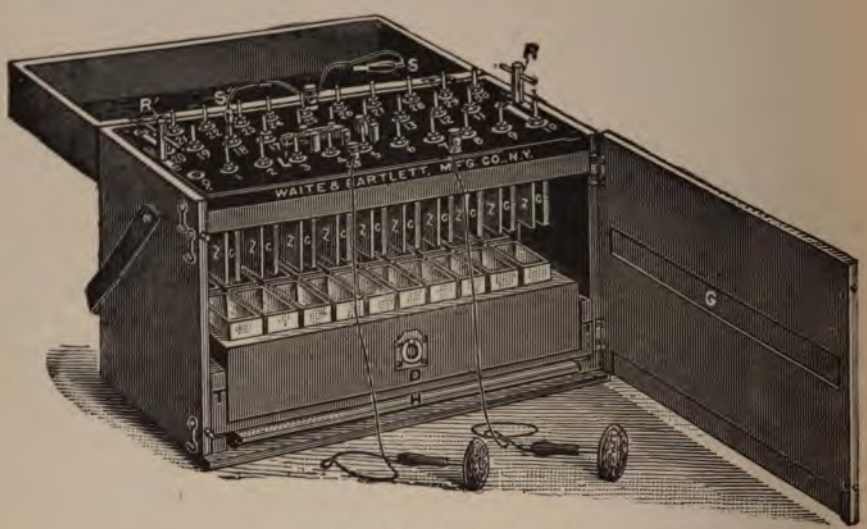


Fig. 5.—Portable Galvanic Battery.

A very convenient and useful portable battery is the one represented by Fig. 5.

In the stationary battery the cells may be either enclosed in a case or cabinet, or else, when in particular the Axo cells are used, they may be placed in the cellar or closet, and thence connected with a key board on the office wall or with a current regulator on a table or shelf. It is better not to buy cheap cells, particularly those known as the gravity cells, or ordinary cells used in telegraph offices, that have been recommended because they can be bought for a song. They will prove, if brought into use, one of

the most disgusting, temper-spoiling, unreliable, and the most expensive (in the long run) in the market. Choose a neat, clean cell; it will give better satisfaction, keep in repair longer, and besides, most important of all, it will furnish the most reliable and continuous current. A cell that is all this will be the Axo *cell*—a form of closed Leclanché cell. Many of the stationary batteries furnish both the galvanic and faradic currents, and are so arranged that the galvanic may be readily interrupted, thus placing at our disposal the galvano-faradic current. Obviously it is advantageous to possess a combination battery, provided only that the faradic elements are independent of the galvanic. Every battery is furnished with a current selector, which enables us to bring as many of the elements as are desired into the circuit; but in this day of exact science it should be the desire of every one who uses the electric current to make it as exact as the plan regulating the administration of drugs. To bring this about it is necessary to have an arrangement of various apparatuses, so when we are asked the question regarding the dosage, effects, and frequency of application, we can be equally as well informed as the electric-lamp man, who can tell you the size of a dynamo that will be necessary to light so many lamps in his district; or the telegraph manager, who can tell the number of cells necessary for the working of a line from A to B. A step in the right direction is the laying aside of the current selector, that required all results to be mentioned in the number of cells in dosage, this being just about as accurate as recommending mouthfuls as a dose instead of drachms or ounces. A full description of the plan will be given under the head of Apparatus.

The two watchwords in electric therapeutics are *cleanliness* and *attention* to *detail*. Upon these two conditions rests success or failure in electro-therapy. Whatever the form of battery, it should be carefully attended to in order that the cor
and the instrument not dama

FIG. 6.—Cabinet Battery.

otherwise the instrument will fail in what is required

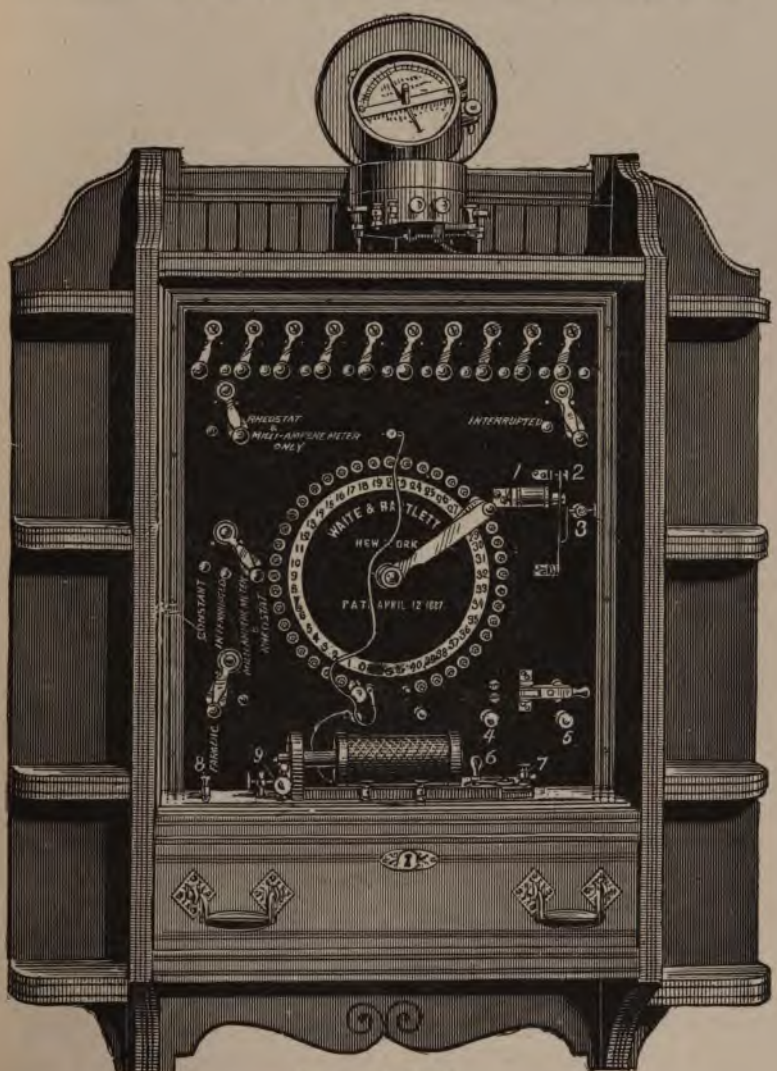


Fig. 7.—Key Board.

of it, and there will be inevitable disappointment in

the results obtained. If one would be successful in the use of the battery, there is no royal road; it must be by plodding and experiment. In unoccupied moments dissect a cell or a coil, or any other apparatus, and see how it is made. Study out the whys and the wherefores; then, when a little annoyance comes in the shape of an interruption or suspension of the current flow, the reason will be known, it is remedied at once, the patient goes on with the treatment, and no one is the wiser. The apology given for going so much into simple detail regarding all these things is the knowledge that so few physicians know anything about them, and they are necessary to be so learned before the force generated can be used intelligently. The gynæcologist must know his battery and how to use it and not misuse it, even as the engineer must know his engine in order to obtain the requisite speed without injury to the source; and it is a very deplorable statement to make that there has been and is more blind ignorance shown in the application of electricity in gynæcology than in any other department of medicine, and most of it is owing to the utter want of knowledge of even the first principles of electro-physics. Following the example set by many who use the electric current, one might as well start out to be a surgeon because he has an amputating case, or a dentist because his grandfather gave him a turnkey, as to use electricity because he owns the finest made and best improved battery in existence, when he is totally ignorant of the difference between the faradic and electro-magnetic currents, or expects to get a faradic current from a galvanic battery. These are facts drawn from experience. A very essential point, on which we would lay renewed stress, is the strict necessity of recognizing and of differentiating the positive from the negative pole. The majority of galvanic batteries in use to-day are provided with a so-called pole changer, which will tell us at a glance which is the negative and which the positive pole, and which also enables us to change these poles at will—something

which in gynæcology is rarely advisable during the application of electricity. At the outset we should determine which pole we wish to utilize as the active one to meet the special indications, and it should remain the active one unless the indications change. When the properties of the galvanic current are thoroughly understood, the operator, bearing in mind the peculiar properties of the two poles, will have no difficulty in selecting the active one for the special case. Thus, in general, when one wishes to lessen congestion, allay pain, or aim at causing absorption, the negative pole (cathode) will be the active one; to check hæmorrhage, cauterize and stimulate, the positive anode must be the active pole. The effect of these poles, in degree, will vary, of course, with the intensity of the current—a point to which we will refer somewhat at length further on. By the term active pole we mean the one which is directly applied to the part which we aim at affecting. This will be more fully explained when we come to the special applications of the current.

FARADISM.

The *Faradic* or *Induced* current of electricity differs greatly from the galvanic current, though it possesses similar properties in a less degree. The galvanic current is the power that produces the induced form of current. By induced current is meant a counter-current of electricity flowing over the course of an actual current of electricity through some conducting material, without being directly connected with the actual current, and flowing in a contra-direction. Fig. 8 illustrates the induced influence or current.

This neat experiment can be performed by taking an Axo cell from the battery, and attaching to the carbon pole one end of a silk or cotton covered wire about a foot long. To the other end attach the zinc element, as represented in the figure. Then take a small ordinary mariner's compass and make two or three turns of the wire

about it, being careful in the winding, so that the turns will coincide with the magnetic needle when at rest, as north and south. Now, if the zinc element be placed back in the jar, the moment the zinc touches the liquid it will be seen that the needle has left its position, caused by the inductive influence of electricity the moment it began to flow. It is preferable to use a *galvanoscope* or *galvanometer.* These names are given to apparatuses for detecting the presence of a current of electricity and to approximate a measurement of it. These instruments

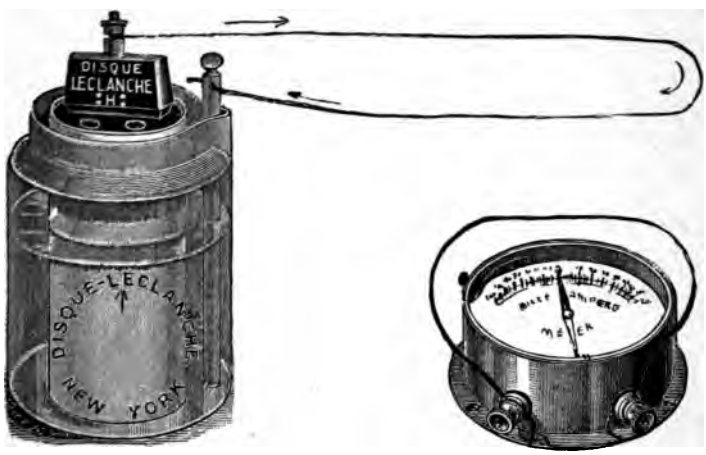


FIG. 8 —Induced Current.

consist simply of a magnetized needle suspended on a pin or by a thread in a brass case. Around this case are wound one or more turns of wire covered with silk, keeping clearly in mind the relation to the needle in the compass just mentioned, and then the ends of the wire—previously made bare by taking off the silk—attached to the base of the binding posts seen in the figure, that are on either side of the meter, and to which the wire is connected. The instant the current flows, that moment the needle is turned, or, in general language, it is deflected from point N in compass and zero in galvanoscopes and galvanometers.

The second great fact noticed is that when the wire transmitting a current of electricity is made spiral between the ends attached to the galvanic cells, and a piece of soft iron or a bundle of small soft-iron wires is placed within this spiral roll, it is found that the iron becomes magnetized, and remains in that state so long as a current is flowing over the wire; but when the current is stopped the magnetism is lost, it proving to be only a temporary magnet. Faraday was the one who noticed this phenomenon, and wondered if it would act in a reverse manner; when he found that if a permanent magnet should be introduced into the spiral wire after removing the soft-iron wires, the needle would be deflected as it was in the previous experiment. In these two experiments it was shown that a wire conducting a current of electricity is capable of exciting another electrical current in a wire that is placed very near it but not connected with it. And, further, there is another condition of induction that we must notice more fully in order to clearly understand the phenomena of the intensity coil, and that is the action upon itself and not upon the separated wire previously mentioned. This can be demonstrated by taking a piece of wire about one foot and a half long, attaching one end to the negative pole (cathode) of a cell, and when the other end of the wire is brought in contact with the positive pole (anode) a minute spark is developed. This spark was produced by the burning of the wire by the simple power of the current from the cell.

Another interesting condition is manifest when the shape of the wire is changed into the spiral form, or helix, and the loose end is applied to the positive pole as before. The spark is intensified in consequence of increased burning of the wire, due to increased inductive power of one fold of the wire upon the one next it. And, again, the spark will be further increased if a rod of metal or a bundle of wire be placed in the helix before being brought in contact with the positive pole. This is caused by the

iron rod or bundle of iron wire in the helix becoming magnetized by the flow of the current round it, and this magnetized rod has acted on the helix, and thus the power of the current is increased.

These increasing intensities can be seen if a galvanometer be placed in the circuit. When the current from the cell is broken, the magnetic needle will be deflected

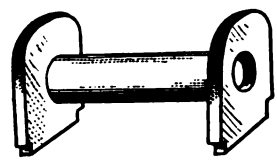


FIG. 9.—Spool.

more and more, but only at the time the current is broken. It simply shows increase of intensity, and in no way gives a measurement of the current. It is impossible at present to measure the quantity of an induced current. From the previous experiments it has been shown that by arranging the connecting wire of the two poles of a galvanic cell into the form of a helix, some

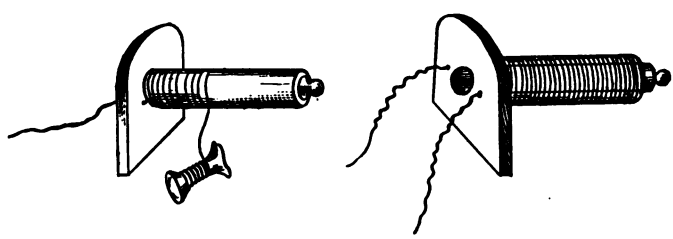


FIG. 9b.—Winding of Spools.

properties of the battery are very much increased. When a long wire is used it is best to make four or five spiral windings, one over the other, carefully placing something between each turn to prevent the coils from touching each other. This helix is called a coil. This brings us to consider the construction of a *faradic or induction coil*, the parts of which are: a galvanic cell or

cells for generating the electric current; a spool turned out of wood, or made of paper and wood, the ends being wood and connected by a thick paper tube (the spool for

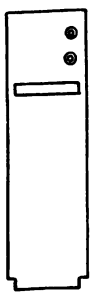


FIG. 10.—Base of Spool.

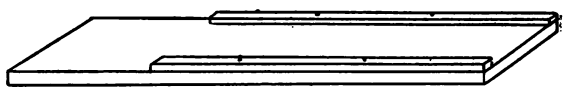


FIG. 10*b*.—Base of Coil.

this part of the machine has but one end, this end to be fastened to baseboard), Fig. 9; a baseboard, Fig. 10; a

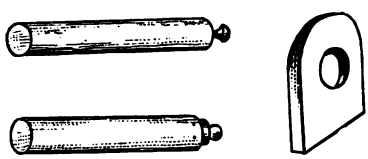


FIG. 11.—Brass Tube and End of Spool.

FIG. 12.—Bundle of Iron Wire.

brass tube, Fig. 11; a bundle of iron wires or an iron rod, Fig. 12; a vibrating hammer or spring, Fig. 13*a*; a

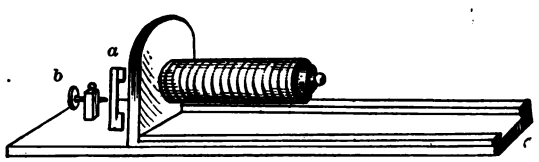


FIG. 13.—Vibrating Spring (*a*).

connecting post, having a screw passed horizontally through it for adjusting the spring of the hammer, Fig. 13*b*; two binding posts for attaching the connecting

wires from the cells, Fig. 14; two more binding posts for the cords of the electrodes, Fig. 14; and a thick wire (No. 16), seventy-five feet long, carefully wound around the spool with one wooden end on the baseboard. This is the primary coil, or primary current. The next part is the secondary or induction coil. The double-ended spool is here used, having a fine silk-covered copper wire (No. 36) carefully wound and separated (insulated), six thousand two hundred feet long, Fig. 14; and two binding posts, Fig. 14, for the application cords to be attached. This current is induced by slipping the secondary coil over the primary, the current increasing in power as it is slid toward the end of the primary one. For gynæcological use a faradic battery, arranged on the two-coil plan, is the best.

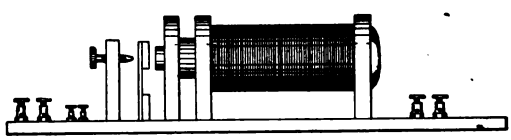


Fig. 14.—Complete Coil.

The faradic current is chiefly mechanical in its effects. It is an interrupted, to-and-fro current, instead of being a constant, continuous. Its chemical action is very weak, if it exist at all, and its main utility is for causing contraction and thence stimulating. The action of the battery is developed through the following plan, using the two-coil apparatus for demonstration: The wire coming out at the head of the spool of the primary coil passes through the baseboard and is carried along the under side to two binding posts, one wire extending to a post to which is attached a wire connecting it to a pole of the galvanic cell. The other wire from the coil is carried along in a serpentine way, and is first made fast to a binding post to be used for the cord having the electrode to be applied to the patient, thence to the post having the adjustment screw for the spring hammer, and these ends are firmly fastened by screwing on a nut and washer.

The next connection is made from another binding post that is to receive a wire connecting it with the other pole of the battery. From this post the wire is carried first to a post placed close to the one already mentioned to receive the cord for electrode; next from this post the wire is carried along to the post that has the vibrator or spring hammer, and there ends by being made fast by a nut and washer. By carefully studying the annexed plate one will see that the course of the current is from the positive pole of the cell to the binding post for the connecting wire; from this post to the one for the electrode cord, marked P in batteries; thence along to the post that has the vibrator or spring hammer attached, and is there made fast. This completes the first course.

A wire attached to the negative pole (zinc) passes to

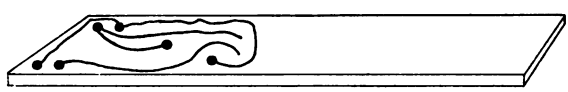


FIG. 15.—Course of Wires.

the binding post alongside of the post that received the positive-pole wire; from this post it is connected directly with one of the wires of the primary coil passed through the baseboard, and there ends. The next connection is made with the other end of the primary coil wire, which passes to the remaining post for cord attachment, marked in batteries N; from thence to the post that has the adjustment screw. By carefully tracing out the course just mentioned, one will reach a point where there is no connecting wire. This is the great point of difference between the galvanic and faradic currents. The jump or break that is necessary makes the faradic current.

Having thus defined the coil, a few words to describe the passage of the electric current and the phenomena connected therewith. This is only the primary coil and current. The moment the connection with the battery is made, the current is at once liberated and passes from the cell to the binding post, thence to the coil of wire sur-

rounding the spool, that contains a bundle of soft-iron wires or iron rod; when the wire or rod becomes a temporary magnet that draws the spring hammer away from the adjustment screw, which when thus drawn cuts off the current. The moment the current is off, the iron wires lose their magnetic power, and immediately the spring carries the hammer or vibrator back to the screw. When the screw is touched by the spring the current is re-established, the iron core is again magnetized and draws the hammer as heretofore, and continues thus to do as long as the current lasts, producing in the rapid vibration the sound of an angry bee. Thus the current passes through the hammer, thence to the screw, along the wire around the helix, back to the negative zinc pole. The influence of the current may be changed from very rapid to quite slow vibrations by increasing the tension on the spring by the adjustment screw.

Poles of the Faradic Battery.—The difference between the poles is not so marked as in the case of the galvanic current, but one should be governed in the selection of the pole by the rules of influence of the galvanic poles. There is no way of changing the peculiarity of the different poles, except to attenuate the influence. The positive pole, however, is more sedative, and the negative more stimulating.

The influence from the two coils varies. The coil of thick wire—primary coil—gives a current of quantity and is especially useful for exciting muscular contractions. The secondary or induced coil, made of thin wire, gives a current of tension and has a marked sedative effect.

These differences in the utility of the faradic current have been in particular emphasized by Apostoli, of France; Lapthorn Smith, of Canada; and Engelmann, of St. Louis, in connection with the electro-therapeutics of the female genital organs.

The gynæcologist should either possess a separate portable faradic machine or else a combination galvano-

faradic battery. There are so many excellent faradic apparatuses obtainable nowadays that the difficulty will not lie in obtaining a good one, but rather in selecting one from others equally good.

For office and general work a fine, durable, and reliable

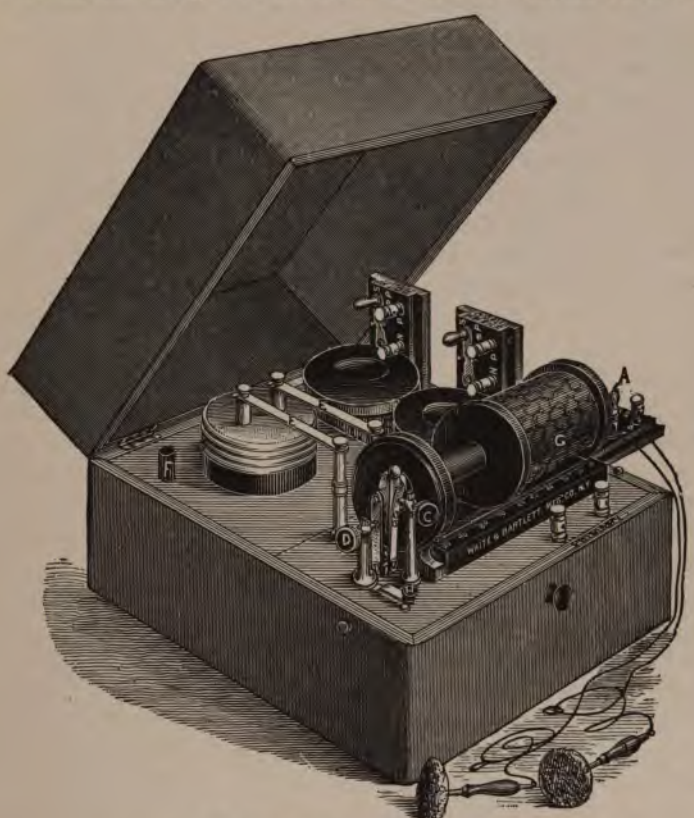


FIG. 16.—Engelmann Faradic Battery.

separate-coil apparatus is made by the Waite & Bartlett Manufacturing Company, designed by Dr. Engelmann, of St. Louis; and the Du Bois Reymond separate coil made by Fleming & Co., of Philadelphia.

For gynæcological work no battery will give the satis-

faction and do the work so well as a two-coil apparatus. It is not necessary to further especially describe nor enter into details in regard to management, for the reason, even as with the galvanic battery, that these are points which can alone be properly learned practically.

One word in conclusion. Treat the battery as you do a horse for time and bottom, and rank it with the other instruments, and keep it as they are kept. "*Keep the battery clean and the points polished,*" and give great care to little details, and it will be a ready servant and do what nothing else will. When electricity is used as a routine measure in gynæcological practice, we believe it preferable to possess one of the combination apparatuses, because, although only exceptionally useful, it may be desirable to utilize both currents at once.

DESCRIPTION OF APPARATUS.

The Milliampèremeter.—This instrument is one of the most important instruments in the scientific outfit of a thorough electro-therapeutist. It bears the same relation to the dosage of electricity as the scales and weights of the dispensing pharmacist; and one might equally expect to be a reliable and accurate dispenser of drugs without the scales and weights, as to know what he is doing with his electric current without the milliampèremeter. Notwithstanding, there are those who delight to call it a toy. All who resort to electricity should use the instrument with accuracy and system. It is an instrument which the gynæcologist should possess in order to use electricity intelligently. It is an instrument by means of which the intensity of the current may be measured, so that we may be enabled to estimate accurately the dosage administered to the patient. It was formerly the custom, and is still largely so among gynæcologists, to use as a guide the number of cells brought into the circuit; but this is a rough method and inaccurate, seeing that the internal and external resistances vary so markedly. To record our results, therefore, and

to know exactly what we are doing, it is essential to include a galvanometer in the circuit. We are speaking

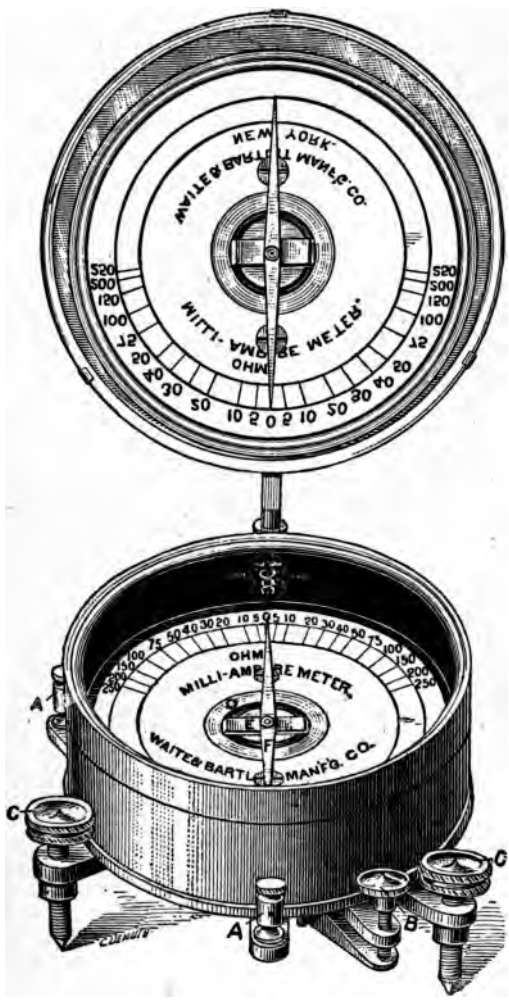


FIG. 17.—The Galvanometer, or Milliampèremeter.

now purely of the galvanic current, for the measurement of which alone is the instrument of utility.

The galvanometer is subdivided into milliampères, the unit of electrical measurement, and the instrument is, therefore, ordinarily spoken of as a milliampèremeter. For routine purposes an instrument registering from forty to fifty milliampères is sufficient, unless, indeed, it should prove expedient to follow in the footsteps of Apostoli and Engelmann, who use intensities as high as two hundred milliampères and over, as we will note when we speak more in detail of the selection and the strength of the current. Sufficient here the statement that, except where electrolysis is aimed at—a subject

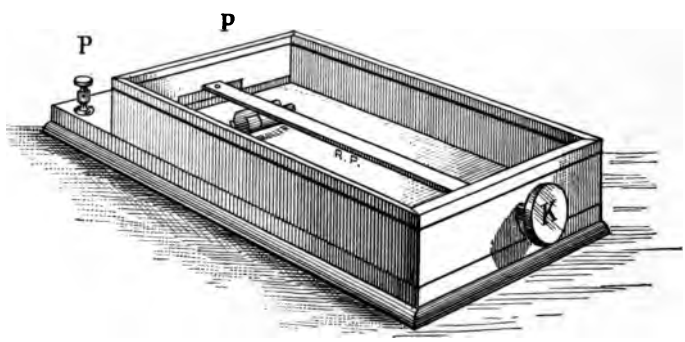


FIG. 18.—Gunning's Current Regulator. R P, resistance plate, over which roller is turned; P P, binding posts; K, screw.

which will be considered in a separate chapter—forty to fifty milliampères will answer for routine work.

The Current Regulator.—This is the next instrument to which we refer as strictly essential to the gynæcologist. It subserves the purpose of interposing in the circuit resistances, so as to modify the strength of the current and to increase the quantity of current without shock, which must occur when increasing the current cell by cell, as in using the selector. We thus alone can avoid giving the patient a shock—something the repetition of which she naturally fears, and which may interfere with further treatment. The one best suited for use is that represented in Fig. 18. It has

been devised by J. H. Gunning. A great drawback to all the plumbago current regulators is their uncertainty of action after a short section of resistance surface has been traversed, when suddenly a jump occurs and the whole amount of current is passed through the tissues. This is caused by two conditions: First,

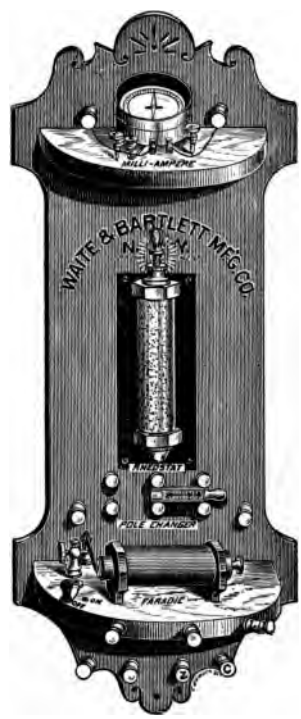


FIG. 19.—Milliampèremeter and Rheostat.

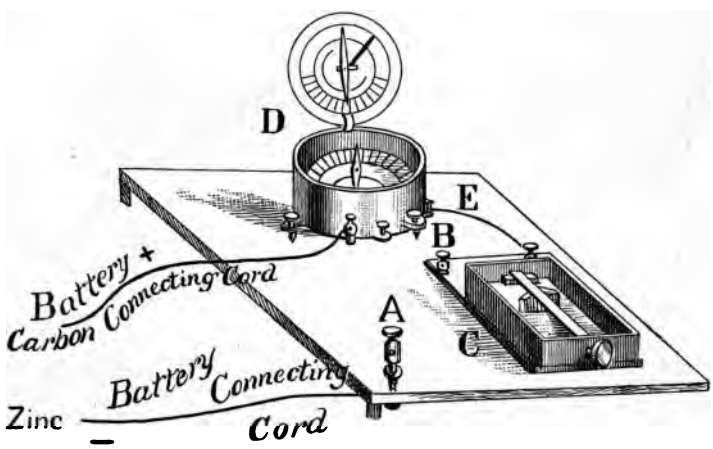
the spring cannot fit and keep closely applied to the resistance surface as the regulator is usually made; and, secondly, the plumbago must be mixed with some other metal ingredient. Gunning's current regulator is so arranged as to overcome these objectionable points. First, the stage is so adjusted that the tension is even all over the surface, causing equal pressure throughout

from points of resistance plate to the base; and, secondly, because the resistance plate is not pure plumbago, but a triple compound. It is very easily used and is free from any metallic points or anything else that might occur to injure the patient. The current regulator is attached to the battery by the binding posts at the end, and the current is permitted to enter the circuit by turning the knob K, which gradually brings the roller (marked Roller, or R) over the resistance plate (marked R or R P), thus gradually lessening the resistance until the base is reached, when nearly the entire current of the battery is passing through both the regulator and tissues to which it has been applied. It is not necessary to have a current selector when using the current regulator. The cells may be arranged in series—that is, attaching a zinc to a carbon through all the cells it is desired to use. When all are connected two elements will not be included, one at the commencement of the series, the other at the end—zinc in one place, carbon at the other. All that is necessary is to carry a wire from one element and fasten it to a permanent post in the cabinet, on the shelf or table that is intended for use, and the wire from the remaining element goes to the binding post of the regulator. From the other post of the regulator connect a wire to be carried to the milliampèremeter. From the second post of the meter attach the cord by which you are to treat the patient. The remaining cord for electrode to patient is attached to the binding post first mentioned. When all is ready turn the roller until the desired amount of milliampères is registered on the meter, bearing in mind that the connection made from the carbon element is the positive pole, and the connection with the zinc is the negative pole. Again, the milliampèremeter may be the first to receive the cord from the binding post, and one cord of the meter attached to binding post of the regulator, using the unoccupied post of the regulator for the cord connecting electrode. Both ways work equally well. One advan-

tage is obtained by the last plan : the regulator may be attached to the operating table and thus used with less fatigue and possibly more readily. It is often used by us after this method.

ELECTRODES AND THEIR GENERAL APPLICATION.

Having sketched the nature of the electric currents of use in gynæcology, their general application, and the



A Post for Attaching Cord to patient Neg. Pole −
B " " " " " " " " Pos " +
C Current Regulator
D Mille Ampère Meter
E Connecting wire Joining Meter with Current Regulator

FIG. 20.—Milliampèremeter and Current Regulator.

means for measuring and modifying them, it remains to speak of the agents by which these currents may be brought to bear on the pelvic organs. These agents are called electrodes.

The electrodes are internal and external, and it is of prime importance that they should be well constructed, else they prove bad conductors, and, even though we

have secured the proper current and have carefully measured the dosage, our therapeutic aim is defeated through the loss of a great portion of the current.

The external electrode in general use consists of a sponge embedded in rubber sheeting to protect the clothing of the patient. This sponge electrode has, however,

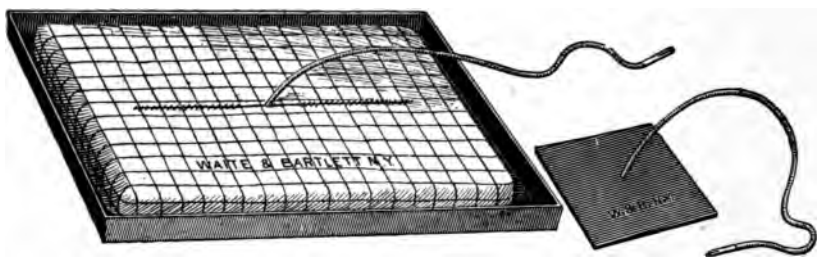


Fig. 21.—Clay Pad.

been rejected by the advanced workers in gynæcological electro-therapy, for the reason that it is bulky, dirty, and a source of loss of current owing to the considerable resistance which it opposes to the passage. In its place have been substituted plates of block tin or of sheet lead, which Engelmann has had perforated with holes one line in diameter and one inch apart. These plates, being

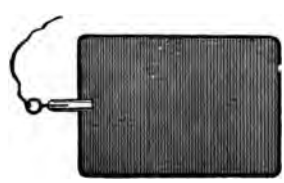


Fig. 22.—Wire-gauze Electrode.

pliable, readily adapt themselves to inequalities of the surface on which they are applied, and they are covered with a thin layer of absorbent cotton, with chamois, with punk (Engelmann), or with rough towelling. The towelling may be cut in sizes to cover the plates, and is held in place by pieces of tape. A further advantage of these

plate electrodes is that the material which covers them may be changed for each patient—a much more cleanly method than the use of a sponge. Apostoli covers the abdomen with a layer of potter's clay. These plates would be much better if clay was used instead of towelling, saving thereby considerable wear on the battery, besides making better connection with the skin. The plates should vary in size from four to ten inches in diameter, the general rule as to choice in size being

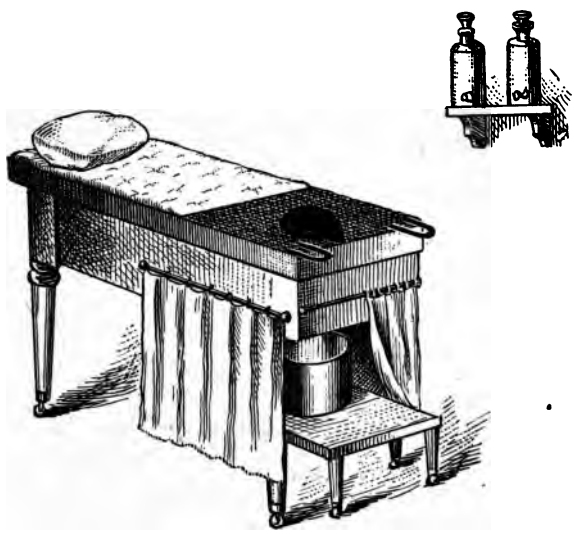


FIG. 23.—Gunning's Table; *b*, Douche Bottles.

simply that the greater the number of milliampères used the larger should be the plate, since the wider the external surface over which the current is disseminated the less the pain. If the abdomen is sponged off with acidulated water or diluted vinegar, the skin is cleansed from grease and salts, the horny scales are softened, thereby making a surface of markedly less resistance and causing much less irritation to the skin. Engelmann uses external electrodes with the following measurements: 6¼ by 9¼ inches; 4½ by 6¼ inches; 3½ by 4½ inches. The

smaller electrode he does not use with currents over twenty milliampères, the medium with currents over sixty milliampères, and he uses the larger with currents over this number. Where electrolysis is aimed at, the external electrode should be large enough to cover as great a surface as is possible, in order to effectively disperse the current at the non-active pole; and this object Apostoli attains through the use of potter's clay.

These plate electrodes are in general applied over the abdomen or the sacrum. Where the object is indirect electrization, both these regions are covered; where the aim is direct electrization, the abdomen is, in general, the preferable site. They should be moistened in warm water, in order to increase their conductivity and to diminish the resistance of the tissues, for a dry surface offers greater resistance than a moist. It is customary to use salt water for moistening the electrodes, in order to intensify the superficial revulsive effect of the galvanic current. Engelmann rejects this practice, and says: "Salt must be avoided. It is not necessary, as it was for the poorly conducting sponge electrode, the instrument which I suggest being a much better conductor; and salt is injurious to patient and to instrument. When used upon electrodes by which currents of high intensity are applied, the electrolytic action of the galvanic current decomposes the salt, and chlorine is developed at the positive pole, by which the amount of pain may be increased and the electrode is corroded." Beard and Rockwell, on the other hand, claim that the use of salt water is an excellent check against the administration of too strong currents, salt water being a much better conductor than simple water, and hence a patient will sensitively feel a current where salt is used which otherwise she would not notice at all. Where, however, a galvanometer is used to gauge the strength of the current, and a large electrode for dispersing it externally, it would seem preferable to dispense with salt, except where we desire the patient to be conscious of the passage of the

current for the moral effect, for otherwise, in gynæcology, it is desirable that our manipulations should be as painless as is consistent with therapeutic effect.

The internal electrodes are either vaginal, cervical, uterine, rectal, or vesical, since it is obviously possible and desirable to utilize all the cavities adjacent to or in con-

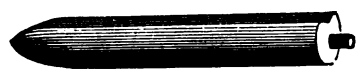


FIG. 24.—Vaginal Metal Electrode.

nection with the pelvic organs for the localization of the electric current. These electrodes should be covered with chamois or absorbent cotton, except where caustic effects are desired.

The vaginal electrode shown in Fig. 24 is of use for making applications to the walls of this canal, or else we

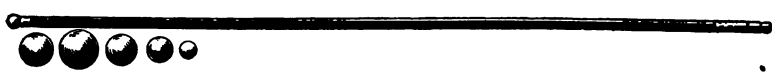


FIG. 25.—Ball Electrode

may use a sound (Fig. 25) on the end of which metal balls of various sizes are screwed, this latter form being especially applicable to instances where we wish to localize the current at a special point of the vaginal vault. This same sound with the smaller ball attached may also

FIG. 26.—Rectal Electrode.

be used as a vesical or a rectal electrode, and, on account of its small size, it is peculiarly adapted to virgins. The metal staff may be effectively insulated by slipping a piece of gum elastic catheter or of rubber tubing over it. A convenient rectal electrode has an olive tip (Fig. 26). For the cervix a cup-shaped electrode answers well, and

in the cervical canal, where it is patulous, the small ball electrode may also be used.

These electrodes can be used, but are not so practical as some of more recent make—as, for instance, an electrode so constructed that the poles may be brought nearer the organ or condition to be treated, and thus concentrate the influence of the electric current. This can be obtained in a better and surer way by the use of a bipo-

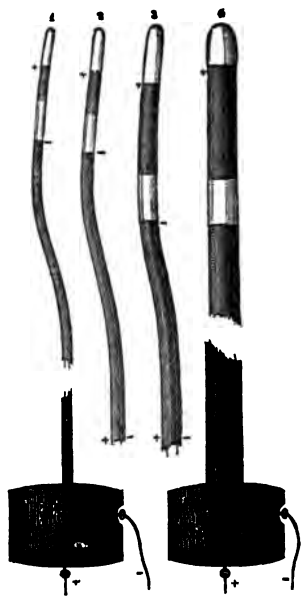


FIG. 27.—Apostoli's Bipolar Vaginal Electrode.

lar electrode—that is to say, an electrode that has the two metal poles carefully insulated on one instrument, as suggested by Dr. Apostoli, of Paris. Thereby we do away with the external use of towels, sponges, etc., as electrodes on remote portions of the body, making it much more agreeable to the patient by removing all the dangers of having clothes wetted by the water from sponges, at the same time simplifying the application. The bipolar electrode is not only cleaner, but from experi-

ment it is shown to be the only proper instrument for the application of the faradic current (as a rule) in the treatment of the organs of the pelvis, male or female. A bipolar electrode is most serviceable if its poles are movable and not so stiff that it cannot be bent. An electrode that can be manipulated in almost every way to facilitate application and adaptability to most curves, etc., met with in the pelvis, and at the same time allows

FIG. 28.—Gunning's Bipolar Vaginal Electrode.

the change of the position of poles, is Gunning's flexible sliding vaginal electrode (Fig. 28).

For intra-uterine electrization there are a number of electrodes at our disposal. They are differently insulated, according as it is desired to act on the entire endometrium or only on the fundus. In the first instance the insulation is to within two and one-half inches of the tip, and in the second up to about one-quarter of an inch,

FIG. 29.—Gunning's Bipolar Uterine Flexible Electrode.

In certain instances, as will be noted in its proper place, it is desirable to confine the current entirely to the uterus, and then a special electrode is needed. It is in this connection that Gunning's bipolar flexible electrode has proved of such service. In the first place, it can be bent and curved so as to overcome the difficulties of flexions and versions; it can be twisted like a corkscrew, thus facilitating entrance into the neck of a flexed uterus. It

thus opens up a line of application never before attainable. The points are slim and small; are made of a material cheaper than platinum, but equally lasting and not easily oxidized, if at all, and it does not cost more than one-third as much. And, further, experiment has

FIG. 30.—Beard's Intra-uterine Electrode.

shown that it is impossible to contract a non-gravid uterus in any other way than by a bipolar electrode.

The bipolar electrode will be referred to again when speaking of the application of the galvanic current. Other special advantages of this electrode are: Suppres-

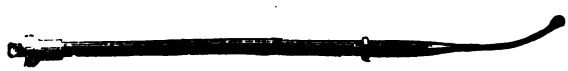


FIG. 31.—Intra-uterine Electrode.

sion of the cutaneous pole; concentration within the uterus of the entire electrical action; diminution of pain owing to the absence of any application of the current to the skin; its greater efficacy, since the highest degree of uterine contractility is obtainable with ease and the

FIG. 32.—Bipolar Vaginal Electrode.

least pain from the use of stronger currents, of greater intensity, and consequently more active (Apostoli).

The *abdominal* or *external electrode*, the next instrument to be described, is one of the greatest importance to the electro-therapeutist when using the strong continuous galvanic current of electricity in the treatment of

the pelvic organs of women, particularly of fibroma, where the current strength is so great. It must be made of such material as can be readily adapted to the irregularities of the cutaneous surface, and should be of a size

FIG. 33.—Gunning's Vaginismus Electrode.

that will allow a very large surface of exposure, thereby lessening the irritation to the skin and allowing a diffusion of the electricity over the entire mass, thus causing as little pain as possible when the current is flowing.

FIG. 34.—Insulated Vaginal Electrode.

The most suitable substance for this purpose is clay, suggested by Dr. Apostoli, and it is the best and only substance that should be used for this purpose, notwithstanding the complaints against it. The clay should be

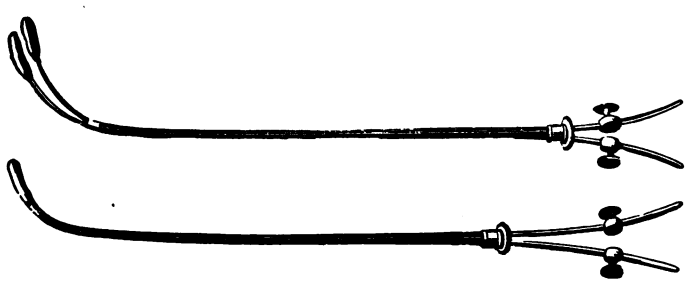


FIG. 35.—Duchenne's Double Uterine Excitor.

of such consistence that it may be easily handled and modelled into a cake of sufficient size to cover the tumor, and it should be placed upon the part selected, either the abdomen or the back. The care of the clay, its applica-

tion, etc., will be fully described under the treatment of fibroma.

The electrodes are connected with the battery by means of conducting cords of different colors, in order that the operator may recognize at a glance the negative

FIG. 36.—Tripier's Double Uterine Excitor.

from the positive pole. As has already been stated, the poles of a galvanic battery are essentially different in their effects, and their individual properties must ever be utilized according to strict indication. The diagnosis once made, the operator should select the pole which he

FIG. 37.—Fry's Cervical Electrode for Stenosis.

desires to utilize, and the current strength should be drawn from it, the current from the other pole being spread over a large surface and thus neutralized. This refers, of course, to direct electrization, where one electrode is internal and the other external. The electrodes

FIG. 38.—Cup Cervical Electrode.

should always be placed in position before the circuit is closed, and they should never be removed until the circuit has been opened. Great care should be exercised in the closing, and the opening should ever be gradual, the aim being always to avoid unnecessary shock to patient.

This can only be accomplished by aid of a current regulator.

Important questions which we must now consider are in regard to the proper intensity of the current and the duration of the application—questions which are in a rather unsettled state, and which further experience is necessary to finally settle. Until quite recently weak currents and long séances were the rule, and have yielded quite satisfactory results, the sittings varying from fifteen to thirty minutes each. Latterly, however, a number of observers have published results obtained from the use of stronger currents in far less time, and a study of these results forces the conclusion that in gynæcology we have been travelling rather more slowly than is at all requisite; for no one will gainsay the assertion

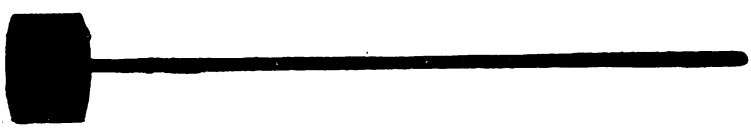


FIG. 39.—Apostoli's Intra-uterine Bipolar Electrode.

that if a given result is obtainable in less time from the use of strong currents, these should be resorted to by preference, provided it can be shown that they are painless and do not injure the patient. The electro-therapeutics of the female genital organs, however, is gradually developing and taking its place in line, owing largely to the fact that instruments for precise measurements of current strength are beginning to be used by gynæcologists, and, therefore, data derivable from experience in their use is not so empirical, but more scientific, and can be utilized for drawing deductions of value.

A recent writer on the subject of the use of electricity in gynæcology says: "There can be no question but that too weak currents have hitherto been used in the treatment of many of the diseases of the female sexual apparatus. Various conditions which I formerly failed to relieve have of late years responded far more readily

to treatment simply because of the greater intensity of current that I have, with increased boldness, attempted." He admits, however, that there is scope for difference of opinion in regard to the number of milliampères necessary to accomplish a given object, and for routine purposes he is for the present satisfied not to exceed fifty milliampères.

Engelmann is the most pronounced advocate in this country of high currents in the routine treatment of the diseases of women, and we instance his views by the following extracts:

"It seems but natural that a current of sufficient intensity to accomplish the desired result in the shortest possible time, without injury to the patient, should be used.

"Hitherto currents altogether too weak to be effective have been used, and to this we must, among other reasons, ascribe the incompleteness of results; it is evident that when a feeble remedy is indiscriminately used, and widely dispersed at that, but little can be expected. Tripier, it may be recalled, speaks of a current of from eight to fifteen milliampères as one of average strength, and calls all over twenty excessive; and Ranney says that 'no patients will endure a current of over twenty milliampères through a high resistance, and that very few will bear over twelve milliampères.' What he calls a high resistance he does not state, and vague assertions such as this merely aggravate the existing confusion.

"How weak the currents used, even by scientific operators, are, is evident from the fact that many galvanometers are not made to register over twenty milliampères, few as high as forty milliampères, and the highest, those of Gaiffe, register not over fifty milliampères.

"To Apostoli is due the credit of boldly passing boundaries which seemed already fixed by practice; in his work hitherto recorded he has used as high as one hundred milliampères, and last fall, during an attendance upon his clinic, he had begun to overstep this then most ex-

treme limit, using up to one hundred and twenty milliampères, and had ordered an instrument which should indicate one hundred and fifty milliampères. A similar one was purchased and brought home, but during the winter's work it was found that even this current strength, hitherto unknown in medical electro-therapeutics, seemed insufficient, and that results could be accomplished more readily and more effectively by currents even stronger. As far as could be judged by the limited range of the galvanometer and by the aid of a current regulator, it was used up to two hundred milliampères. And since then an instrument indicating two hundred and fifty milliampères has been obtained, and a recent letter from Apostoli gives as his experience a precisely similar result, which confirms the belief that a wide range of possibilities is open to electro-therapeutics. Such intensities are possible, and may be called for in gynæcological electro-therapeutics, where we are generally dealing with circumscribed parts, provided the localized polar method be adopted, by which we obtain low resistance and limitation of the current. It must again be emphasized that all that has been said has been in reference to electricity in gynæcological practice, and only to galvanic and faradic electricity, not to static electricity or the current of quantity used for the galvano-cautery. It is not claimed that such strong currents are always judicious or necessary, but, on the contrary, at times only one or two milliampères, often from twenty to forty, more generally from forty to eighty; and we merely wish to establish the fact that, if desirable and necessary to accomplish the effect intended, currents of greater strength can be used without injury to the patient, without causing undue pain, and without the use of anæsthetics."

These views of Engelmann, reinforced as they are by the report of numerous cases in which they were practically tested, deserve serious consideration. For the present it may be stated that much stronger currents

ence being in the length. These instruments are intended for use by the faradic current.

The vesical or bladder bipolar electrode is constructed on the same plan as the uterine, vaginal, and rectal flexible and adjustable electrode, only differing in size.

It remains now to consider more in detail the

Poles of a Battery.—One of the most important things to be borne in mind when using the galvanic current in gynæcology is the difference in effect of the two poles, positive and negative. If a sharp-pointed metal electrode, that is attached to the negative pole of a battery, be passed into a piece of liver or beef, and another similar electrode be passed into the same flesh, one-quarter of an inch apart, and the electric current be turned on, there will be noticed on the *negative* electrode and around it a lot of small bubbles] produced by electrolysis. They are formed of hydrogen gas liberated by the change in the water tissues of the meat. At the same time, if gentle pressure is made upon this electrode it enters the tissues very readily, having rendered the tissues soft and at the same time made them contract on themselves at the edges, thus actually boring out the tissues as with an auger. The cicatrix formed in the tissues, particularly the uterine, is soft and yielding, and not much inclined to contract. Therefore the negative is the pole to use when absorption is in view, or the disintegrating of membrane when no hæmorrhage exists. In fact, it is the best pole to use when not threatened with loss of blood. It is also known as the alkaline pole, in consequence of the deposition upon it of the alkalies of the tissues.

The effect produced upon the tissues mentioned by the *positive* pole is markedly different. While a few bubbles of gas may be seen around this pole, it will be noticed that it is not hydrogen gas, but oxygen. The tissues will look drier and dark, at the same time emitting an odor like cooking flesh. The positive pole is not loose, but firmly held by the change induced in the

albuminous tissue, and also by its chemical action, producing in a mild way a cauterizing effect. This is said to be induced by the marked influence of the acid drawn from the tissues during the electrolysis. The conditions where the positive pole is indicated are in all surfaces where there is a tendency to hæmorrhage, where stimulation is needed. Great care should be exercised, when the positive pole is used, in all cavities where it is necessary to have the canals remain open, for the reason that the cicatrix formed is a strong, contracting, non-yielding one, very much like a cicatrix produced by the application of a strong solution of nitrate of silver. This pole is the aseptic one, though both poles have a great destructive power over germs, and, where large currents are used, will be always clean, as a rule.

UNITS OF ELECTRICITY.

The units used to express certain conditions or stages of the flowing electric current, representing power, resistance, and current, are the *volt*, *ohm*, and the *ampère*. For the sake of convenience, since the ampère represents more current than can be used in electro-therapy, it has been divided into thousandths of an ampère, called milliampère.

The *volt* is the unit of electro-motive force, or the power that starts the electric current, and is confined entirely to the elements within the cell; hence it is said that an Axo cell gives 1.60 volts ; Law cell, 1.33 volts ; Diamond, 1.27 volts ; Samson, 1.35 volts ; Bichromate, 1.90 volts, and so on.

Analogies used to illustrate electricity and its currents are rather far-fetched; nevertheless they will give some kind of a tangible idea which the mind can more easily grasp. It is said a battery has such a voltage ; by that is meant so much power in forcing the electric energy through the fluid in a cell from the generating element to the other, and thence on its course to do a certain amount of work, even as, in very mu

is said a steam engine has so many horse power. Thus it is seen that this unit must be left with the maker of the cell, and is of but little use to the gynæcologist. All the benefit derived from it is simply to know the power of the battery.

The next unit necessary to recognize is the *ohm*. It is the unit of resistance, and for the scientist it is the mathematical unit; but to the gynæcologist it is properly a unit of confusion, and does as much to prevent an idea of the practical use of electricity entering the head of one that wishes to apply it, as to the passage of the actual electric current through substances for conduction. Technically, a copper wire one-quarter of an inch in diameter and one mile long, or a piece of copper wire one-twentieth of an inch in diameter and two hundred and fifty feet long, affords a resistance of about one ohm. It is the unit that is always associated with resistance, and that only; and the progress of the electric current through anything must be measured by it. It may be represented by a man walking in a river against the current: the narrower the stream becomes the greater the current, and the more strength is required by the man to push through it. So it is with electricity: a large wire affords a certain amount of resistance—small, it is true; but as the wire grows smaller the greater the resistance and more work the current has to get through it, until when it reaches a very small wire, such as are placed in incandescent lamps, the resistance is so great that the wire becomes hot. The same thing occurs in the galvanic cautery. The difficulty connected with this unit, so far as the gynæcologist is concerned, will be overcome when the next unit, the *ampère*, is considered.

This is the unit of current, and is equal to the quantity of electricity transmitted by the power of one volt through two hundred and fifty feet of pure copper wire in one second of time. For the purpose of convenience and record the ampère is divided into one thousand parts and called milliampère. It is this division of the ampère

that is used as a standard unit of measurement, and it is the only electrical unit that need be borne in mind for the practical application of the electric current in gynæcology. In a rough way, it bears the same relation to the current of electricity that the gill does to fluid measurement. As it is said a conduit supplies so many gallons of water in a minute through a pipe of given diameter when a pressure of so many pounds is applied, so it is with the current of electricity. A copper wire one-twentieth of one inch in diameter and two hundred and fifty feet long will give one ampère of current every second when a pressure—called electro-motive force—of one volt is present. When a current of galvanic electricity is applied for therapeutical purposes, it should be always through a milliampèremeter in the circuit; then all approximation as to quantity can be neglected. It matters not to the gynæcologist what amount of resistance it is necessary to overcome between the electrodes while giving the current; all that is necessary is simply to turn on the current, by means of a current regulator, until a certain number of milliampères are recorded on the dial of the milliampèremeter. Then we know that the current amounts to that quantity and that it is actually passing through the tissues. If cells are used to express dosage, the results will be as much mixed as they always have been before the use of the milliampèremeter, in consequence of the constant change going on in the tissues day by day. When the tissues are dry the effect of an amount of current given by a certain number of cells is less.

CONTRA-INDICATIONS TO THE USE OF ELECTRICITY.

In the present state of our knowledge of the electro-therapeutics of the female sexual organs, it does not appear advisable to resort to galvanism in the presence of any especially acute process. This, at least, is the safe rule. Subacute inflammations may be very cautiously so treated, even as care is then called for in the applica-

tion of any of our routine methods. Such, at least, is our position. Others are bolder, and do not seem to recognize any contra-indication except personal idiosyncrasy. Possibly the rule we have laid down may be subject to modification in the future; for the present, however, the chief range of value of galvanism is in more or less chronic processes.

With faradism the case is different. There is no agent, short of opium, capable of alleviating the pain associated with an acute pelvic inflammatory process, more quickly than the current derived from the fine wire coil and administered through a vaginal bipolar electrode. The uterine bipolar electrode, we think, had better not be used in the presence of an acute process.

Pregnancy, of course, constitutes a strict contra-indication, even as it does to other uterine manipulations.

CHAPTER II.

ROUTINE USES OF ELECTRICITY.

THE worth of any agent is best decided by comparing the results obtainable with those yielded by others. Further, in advocating resort to any therapeutic means for the relief of disease, it is essential that the causal factors underlying the disease be properly understood. In the pages which follow, therefore, the aim is to take up in succession the several affections of women which properly demand routine office care, accompanying the description of the application of electricity with such views in regard to etiology as seem requisite, and with an estimate of the results obtainable from resort to measures other than electrical. Thus the reader will be in a position to assign electricity to its proper sphere, which is that of an inestimable adjuvant and not of a cure-all. Much of the discredit which in certain quarters is cast at electro-therapeutists is due to the fact that too much has been claimed by the enthusiasts who rush frantically along every new road. Whilst the exact therapeutic value of electricity may not as yet be definitively stated, our experience is certainly ample enough to warrant the assertion that no practitioner can afford to dispense with it in the routine treatment of many of the diseases common to women.

AMENORRHŒA.

Under the term amenorrhœa are included instances where, between the age of puberty and of the menopause, there is entire absence of the menstrual discharge; or else, if present, where it is scanty and irregular. Aside from pregnancy and lactation, where amenorrhœa is

physiological, the chief causes are absence or imperfect development of the essential organs of generation, impoverished conditions of the blood or nervous system, certain organic diseases.

Electricity, in one or another form, has always been a favorite therapeutic agent in case of amenorrhœa. It has been used indiscriminately, without, usually, special individualization of the cause of the symptom, and hence, while results have at times been satisfactory, very frequently they have been disappointing. In dealing with the symptom, amenorrhœa, with the end in view of relieving it, it is of first importance to estimate the cause; for while certain forms of amenorrhœa yield to the persistent application of electricity, in case of others but little hope of relief can be fostered, and in still others positive harm may be done.

Of the instances where electricity is indicated, and yet where it cannot be predicated at all as to what the outcome from its use will be, cases of imperfect development of the essential sexual organs hold the front rank.

Where careful examination, by preference under an anæsthetic, satisfies us that the uterus, the ovaries, and the tubes are present and merely imperfectly developed, then the inference is warrantable that if we can stimulate development we may be able to establish the function the outward manifestation of which is the regularly recurring menstrual flow. There is one factor which considerably aids us in these instances in estimating the probable outcome of the treatment instituted, and this is the presence or absence of molimina. If the woman has never had any of the subjective sensations which accompany the appearance of the menstrual flow—if, in other words, we can gain from her no history which will lead us to think that the sexual system is simply dormant, as it were, and only needs stimulus for full development and action—then the outlook for success from the application of electricity or other stimulant and nutrient agents is very gloomy. Still, even here, seeing that we are dealing

with the function which chiefly differentiates the woman from the man, however improbable the result, resort to the methods shortly to be indicated is but doing full justice to the woman. It should be stated, however, that these are the instances where the attainment of our aim is highly improbable, and where electricity and other agents scarcely ever yield other than negative results.

A further class of cases, where amenorrhœa either absolute or relative is present, are those where the essential sexual organs are apparently normally developed, where the history tells us of irregularly recurring molimina, and yet the woman has either never menstruated, or else scantily or irregularly, or else regularly for a while, when, without cause specially apparent, menstruation has ceased. Such instances are to be sharply differentiated from those where the cause is an impoverished condition of the blood or nervous system, or the presence of some organic disease, or else where the only determinable cause, and this an hypothetical one, is a lack of tone in the sexual organs. Electricity here may be productive of good or of harm, according to the case.

Amenorrhœa in the presence of anæmia, chlorosis, tuberculosis, or Bright's disease, is not a symptom calling for local treatment by electricity or otherwise, but is rather to be regarded as a symptom which strictly contraindicates local measures for instituting the flow. The amenorrhœa is here, in truth, conservative, for these patients have not the blood to lose. In case of anæmia and chlorosis, stimulation of the pelvic organs should only be resorted to after the general state has been improved and the blood has been made richer by such constitutional measures as suggest themselves. In case of organic diseases which of themselves undermine the system and sap the strength, we question the utility of resort to any measures which tend to restore or to awaken function in organs which are quiescent to the very advantage of the patient.

We have left for consideration, then, that large class

of cases where the amenorrhœa is said to be dependent on lack of nerve force or tone—the so-called atonic amenorrhœa, in which the binoxide of manganese occasionally proves of such marked utility. It is in this class that electrization is most effective and gives the most brilliant results. The patients vary very markedly in their characteristics. At times it is a young girl who presents herself, of eighteen to twenty years of age—that is to say, one who has passed the average pubescent age—of good local and general development, free from constitutional disease or taint, with a history of marked molimina recurring each month, neither anæmic nor chlorotic and yet amenorrhœic. At other times the woman has previously menstruated normally and with regularity, but has ceased to do so, as the result, apparently, of sudden, intense nervous shock or else on change of residence—a type so constantly met with in immigrants. In both these instances there seems to be lacking the normal stimulus to menstruation; at least such is the hypothetical explanation which we are forced to fall back upon. At other times, finally, the woman, previously regular, notices a gradual decrease in the amount of discharge at the periods and a lengthening in the intervals, until menstruation ceases altogether, and concomitantly with these phenomena there occurs rather rapid development of adipose—that is to say, the stimulus requisite for the regular and proper function of the genital system is apparently diverted towards making fat.

From this rapid survey of the main varieties of amenorrhœa, which has seemed essential in order to make clear in what instances electricity is likely to prove of value, it is apparent that, before resorting to the agent, strict differentiation of the probable cause of the amenorrhœa is requisite. In brief, the statements may be made that where there is considerable lack of development of the sexual organs and complete absence of molimina, we cannot hope for any result from electricity; in the pre-

sence of anæmia and of chlorosis, resort to local electrization, at any rate, is strictly contra-indicated until the impoverished blood has been made richer; certain constitutional diseases (tuberculosis, Bright's) associated with amenorrhœa are *per se* barriers to local electrization; where simply nerve tone is lacking or nervous stimulus is misdirected, we can be quite confident of obtaining marked results from persistent local and general electrization.

Seeing now that those forms of amenorrhœa which may suitably be subjected to electrization are in general dependent on lack of general or local nerve tone, it is evident that it is on the faradic current that we should place our main dependence. Mechanical effects, not chemical, are essentially called for, and, as we have seen, it is the faradic current which furnishes us these mechanical effects. Such, indeed, is the aim of other methods which are popular in the routine treatment of amenorrhœa. The repeated passage of the uterine sound, the application of stimulating agents to the endometrium, the insertion of tents and of stem pessaries—these means all aim at irritating the uterus, at causing congestion, and thereby leading to development and function. There are instances, however, where something more than mere stimulation is called for, where the local nutrition is at fault; and here galvanization, or preferably galvano-faradization, answers a better purpose than faradization alone. Where there exists imperfect development of the uterus and its appendages, cases which test our patience to an extreme degree, there is required, in particular, resort to both forms of electrization. Cases of amenorrhœa characterized by the presence of molimina, and instances of relative amenorrhœa where there exists a scanty and irregularly recurrent flow, should by preference be subjected to electrization at the time of the molimina and for a few days preceding their appearance. It is then that the essential sexual organs are endeavoring to functionate or are imperfectly doing so, and

when the patient is caused to menstruate, but should be continued for a while until the habit has been acquired or regained. Frequently electricity will yield us better results and in less time than are attainable by other agents.

DYSMENORRHŒA.

Painful menstruation is a concomitant symptom of such a large number of diseases of the female sexual organs that any consideration of its relief by electricity or other means must necessarily be deferred till we treat of the individual affections with which it is associated. There are instances, however, where dysmenorrhœa exists and yet where careful local examination reveals no appreciable cause, such as displacement or distortion of the uterus, or inflammatory affection of the cellular tissue or peritoneum adjacent to this organ and its adnexa, or changes in the ovaries or the tubes. It is ordinarily in the unmarried that this variety of dysmenorrhœa is met with, and for want of a better term the word neuralgic is applied to it. There is present apparently a depressed nervous tone, a lack of nerve nutrition, a local hyperæsthesia, which expresses itself in some by neuralgias in various parts of the body, and in others by dysmenorrhœa. The menses are often scanty; there is non-satisfaction of function, as it were. If we can make these women lose more blood at the menstrual periods, at the same time toning up the nervous system, we can often cure the dysmenorrhœa. In other instances, again, the flow is profuse enough and free enough, but still the pain has the neuralgic type. The diagnosis of neuralgic dysmenorrhœa must be reached purely by exclusion. Absence of evidence of local disease will point strongly to the pain being neuralgic in character.

In the treatment of this variety of dysmenorrhœa such general constitutional measures as seem called for by the individual case hold unquestionably the first place. Electricity, however, properly utilized, will serve as a valuable adjunct. The sedative property of the galvanic

current is obviously called for, and this is best attained by abdomino-vaginal galvanization with mild currents; and it seems to us, with the positive pole internal, that its sedative effect may be more directly utilized. In virgins abdomino-lumbar galvanization should be tested before resort to internal. Exceptionally, and this where the flow is scanty and insufficient stimulus is a probable source of the dysmenorrhœa, the faradic current may be tested cautiously, in the hope that with increase in the flow the pain will diminish. The quantity current is here indicated—that is to say, the current derived from the coarse wire coil. The bipolar intra-uterine electrode should be passed to the fundus, and the uterus should be stimulated to the extent of tolerance on the part of the patient. If thus we are enabled to cause a freer menstrual flow, the dysmenorrhœa will be relieved. Obviously such constitutional measures as suggest themselves are indicated as adjuvants, and the full administration of the binoxide of manganese holds the first rank.

In the vast majority of instances of neuralgic dysmenorrhœa, however, galvanism is the agent *par excellence*. It aims at sedation and at improvement of local nutrition, on the lack of which the pain in a measure depends. Electrization should by preference be resorted to daily for the week preceding the onset of the flow.

Other varieties of dysmenorrhœa will receive due notice when we come to speak of uterine flexions, endometritis, and of peri-uterine inflammatory affections.

SUBINVOLUTION OF THE UTERUS AND OF THE VAGINA.

Under the term subinvolution we understand that relaxed, congested state of the uterus and the vagina which is so often met with after labor at term and abortion. The condition is a subacute one, as we speak of it here, and has not become chronic, when, as will be noted, electricity should be differently used. We are dealing with a passive hyperæmia. The uterus is enlarged, soft,

and succulent. It is heavy, and tends to sink down in the pelvis proportionately as its ligaments and the pelvic floor are similarly relaxed and lacking in tone. There exists not alone uterine congestion, but also pelvic congestion. The symptoms are intensified when the patient is in the erect or the sitting position, and these symptoms are the result of the congestion, which is in turn intensified by the sagging of the uterus. Leucorrhœa, menorrhagia, even metrorrhagia, are the outward manifestations of the general pelvic congestion. There is present an endometritis, but it is purely the result of hypersecretion; it is a catarrhal endometritis, in other words, and not an endometritis characterized by degeneration of the elements of the uterine mucous membrane. We are thus specific in describing the nature of the local conditions, because it is essential to differentiate subinvolution from hyperplasia (chronic metritis), the method of using electricity in the one case differing essentially from that in the other.

In subinvolution of the uterus we aim at emptying the organ of its excess of contained blood, at causing it to contract, at rendering it lighter, so that its tendency to sag downward will be lessened and the peri-uterine circulation be in so far improved. It is at once suggestive how amply electrization will fulfil the purpose of adjuvant to our routine measures. Of these routine measures we are able to dispense with one, and this is resort to intra-uterine applications. In the endometritis accompanying simple subinvolution they are unnecessary where electricity is used. The glycerin tampon, for support and depletion, is the measure which electricity markedly supplements.

As to the variety of the current, since we aim at stimulation, at causing muscular contraction, it is obviously the quantity faradic which should be selected. Further, we wish to stimulate the entire uterus, and not simply to irritate it locally, and therefore faradization is best instituted through one electrode over the abdomen or lumbar

spine, and the other over the cervix (the cup electrode). This, at least, should be the rule at the outset whilst the uterus is large, heavy, and succulent; later, when the organ has become smaller, vagino-abdominal galvanization may be resorted to for the improvement of nutrition. Exceptionally, where the discharges from the uterus are excessive, it is well to precede faradization by a number of positive intra-uterine galvanizations, a current strength of at least fifty milliampères being requisite. The strength of the faradic current will depend here, as elsewhere when this current is used, on the tolerance of the individual. The main points to remember are that the coarse wire coil is to be selected, since the object is to cause energetic uterine contractions, thus emptying the organ of its contained excess of blood.

The result of this treatment will be noted in gradual diminution in size of the organ and lessened tendency to sagging. In the absence of that factor which so commonly keeps the uterus in a state of congestion—we mean a laceration of the cervix—the result from electrization of the uterus will be marked in a few weeks. At the end of each electrization the vagina should be carefully filled with glycerin tampons, in order that in the intervals of treatment the uterus may be held at a slightly higher level in the pelvis, and that thereby the uterine and the peri-uterine circulation may be equalized.

It is apparent, and we desire to emphasize this, that electricity is advocated in case of subinvolution on account of its powerful contractile effects, as a valuable adjuvant to other means for reducing the local congestion. It enables us to dispense with intra-uterine applications, which have always seemed to us of questionable utility in subinvolution pure and simple; and, through its relatively speedy action in diminishing local congestion and its general tonic effect on the pelvic organs, resort to pessaries, which aim at sustaining the uterus at a higher level in the pelvis and at taking strain off the suspensory ligaments, will less frequently be nece

In case of subinvolution of the vagina, faradization, which is here indicated as well in preference to galvanization, may be suitably applied by means of the vaginal electrode; and since relaxation of the vaginal walls is a fairly constant accompaniment of subinvolution of the uterus, both conditions may be treated at one and the same time. Faradization of the vaginal walls improves their tone, stimulates the muscular fibres, and relieves the congestion here as elsewhere.

It seems proper to state that in what has preceded we have had in mind instances of uncomplicated subinvolution. Where a laceration of the cervix exists, it is proper to repair the rent before resorting to electricity or any other agent which aims at curing the subinvolution; otherwise the ultimate result will be inevitable disappointment, since the rent in the cervix is one of the promoters of the subinvolution. Further, if there exist lesion of the pelvic floor which favors the sagging of the heavy uterus, the rule should be first to restore the integrity of this floor by one or another of the operations which aim at this, and then to resort to electricity.

SUPERINVOLUTION.

This condition is the opposite of subinvolution. In the one there is incomplete retrograde metamorphosis, in the other there is excessive. The uterus is smaller than normal, instead of larger; amenorrhœa, instead of metrorrhagia, is an accompaniment. The amenorrhœa need not be absolute, however; there may be a slight periodic discharge of a few hours' duration, although the uterus is lessened in size, and this is a point which materially modifies the prognosis in regard to the result from the instituted treatment. As long as there is evidence of ovarian activity we may hope for success from persistent treatment. In the absence, therefore, of external manifestation of ovulation, the presence of molimina is a favorable prognostic factor. Obviously the treatment called for is stimulation. This may be secured

in a variety of ways, such as by applications to the endometrium, the insertion of stem pessaries, the use of sponge tents; but unquestionably the most direct and powerful stimulant is the quantity faradic current, applied by preference to the interior of the uterus by means of a double internal electrode, or else one electrode externally over the uterus and the other within the cavity. The applications of faradism are called for in particular just before and during the presence of molimina. In the intervals frequent utero-abdominal galvanization should be resorted to, the negative pole being placed within the cavity to secure the local hæmorrhagic effects. Constant treatment of this nature may result in enlargement of the uterus and in restoration of the menstrual periods; for we thus not only stimulate the uterus to growth, but the ovaries as well to function. Where the superinvolution has existed for some time and there is complete absence of molimina, it is questionable if even persistent electrization will be of benefit, although it should always be given a faithful trial. Where the superinvolution is associated with general increase in the adipose of the body—that is to say, where, concomitantly with the decrease in size of the uterus and the diminished menstruation, there has occurred considerable increase in weight from the deposition of fat—such dietetic and general hygienic measures as suggest themselves for overcoming this tendency to adipoiesis should, of course, be resorted to.

CHRONIC OVARITIS AND OVARALGIA.

Under the term ovaritis is understood congestion, or the result of congestion, of the ovary. The organ, on the bimanual, is found enlarged, sensitive, and usually, as the result of increased weight, it lies at a lower level in the pelvis than the normal. The organ, in the cases under consideration, is movable, not fixed. This definition is given for the reason that it is desirable to differentiate sharply simple oöphoritis from that which

accompanies pelvic exudations or disease of the tubes. This latter form will receive due consideration under the head of chronic pelvic peritonitis. The condition we are speaking of will be met with chiefly in the unmarried, as the result or as an accompaniment of menstrual irregularities, imperfect uterine drainage, or sudden checking of the physiological congestion of menstruation. The enlarged, tender ovary we are considering finds its analogue in orchitis in the male. For the relief of the condition, electricity is a most valuable adjuvant to routine therapeutic measures, and withal without the unpleasant after-effects which may follow resort to the only other practically efficient means—the blister over the ovarian region. Electricity will yield the best results if used as follows: When the ovary is large and very tender to the touch, vagino-abdominal galvanization will materially assist in relieving the congestion. The positive bulb-covered electrode should be inserted into the vagina as close to the ovary as possible. The negative pole is connected with the plate on the abdomen, and a current of from thirty to fifty milliampères should be used for from five to ten minutes. The séance should be repeated every other day, and in the intervals the ovary should be supported at a slightly higher level in the pelvis by a cotton or wool tampon. Thus we obtain sedation as well as relief of pelvic and ovarian congestion. When the ovary has become less tender and the local congestion has been lessened, bipolar vaginal faradization every third day will eventually complete the symptomatic cure. It is important to remember that electricity will accomplish this only when attention is also given to the removal of causes of ovarian and pelvic congestion—such as the immoderate use of the sewing machine, over-frequent copulation, chronic constipation. Obviously any complication, such as endometritis or uterine displacement, should be treated *lege artis* at one and the same time.

Oöphoralgia is a term which serves as a cloak for our

ignorance in those cases where we can determine no appreciable local cause of the pain complained of, and yet which from its site seems to emanate from the ovary. In such instances electricity, properly utilized, will oftentimes grant relief. Again it will often fail. Neuralgia in this locality is as erratic as in other portions of the body. Having rigidly excluded as a cause the diatheses—gout, rheumatism, etc.—positive vagino-abdominal galvanism, fifty milliampères on an average for ten minutes, will at times give speedy relief. Where this fails, the tension faradic current through the bipolar vaginal electrode should be thoroughly tested before relegating the patient to surgery. These are the very instances where removal of the appendages can offer little hope of cure, even though all other routine non-surgical methods have failed. At any rate, the problematical nature of the ultimate result of the laparotomy, if electricity should fail, renders its performance justifiable in case of intractable oöphoralgia only where otherwise the certainty is that the patient will degenerate into an opium habituée.

AREOLAR HYPERPLASIA — ENDOMETRITIS — HYSTERO-NEUROSES.

These subjects are conveniently grouped together for the reason that they are very constant associates, and that therefore the methods of treatment applicable to the one will apply to the others.

Areolar hyperplasia, the so-called chronic metritis, is ordinarily the result of subinvolution. Exceptionally, however, it is met with in the unmarried and in the sterile, being then due to repeated congestion. Thomas' definition of the condition cannot be improved upon: "The condition ordinarily styled chronic metritis consists in an enlargement of the uterus due to hypergenesis of its tissues, especially of its connective tissue, which induces nervous irritability and is accompanied by congestion. Decidedly the most frequent source of this

state is interference with involution of the puerperal uterus. A very large proportion of the cases of so-called chronic parenchymatous metritis are really later stages of subinvolution. Areolar hyperplasia is often induced in a uterus which has once undergone the development of pregnancy, by displacement, endometritis, and other conditions inducing persistent hyperæmia. However produced, the condition is one of vice of nutrition, engendering hyperplasia of connective tissue as its most striking feature, and, although attended by many of the signs and symptoms of inflammation, it in no way partakes of the character of that process." Clinically the condition is met with under two forms, according to the stage of the affection. In the one the uterus is enlarged, heavy, more or less succulent. The symptoms are chiefly hæmorrhages and leucorrhœa. In the other form the uterus is dense, contracted; there is little secretion from the endometrium; instead of hæmorrhage, scanty menstruation is a factor; the chief symptoms, however, are the varied manifestations, in different parts of the body, to which the term hystero-neuroses is applicable. Every gynæcologist knows how intractable to treatment areolar hyperplasia is, in its advanced stages particularly, and a proof of this is furnished by calling to mind the many and the varied methods of treatment which have from time to time been proposed. Leeching, scarification, intra-uterine applications of the stronger caustics, ignipuncture, the wedge-shaped excision, etc., etc.—these measures have each and all been tested, and still frequently they fall far short of effecting a cure. Revulsion, derivation, absorption, is what they all, in the main, aim at, and from what has gone before it is at once apparent that electricity ought to be of marked service. In what follows in regard to the use of this agent, we take it for granted that in the treatment of any individual case any marked irritant and promoter of the hyperplasia, such as a laceration of the cervix, will be removed before resorting to electricity.

The problem before us is, first to cure the endometritis and next to soften down the hyperplastic tissue which, probably through nerve compression, is responsible for the hystero-neurotic symptoms which are uniform accompaniments of the advanced stage of the affection.

The endometritis, ordinarily, is associated with the presence of fungosities of the endometrium. Such, at least, is the case in instances of hyperplasia where the history tells us of hæmorrhages and of leucorrhœa. There are two methods at our disposal for attacking these vegetations. The first is thorough curetting, the other is positive intra-uterine galvanization. The disadvantages of curetting are the facts that the procedure is an operation ever to be resorted to at the patient's house, requiring usually anæsthesia, and always rest in bed for a variable time afterwards. Many patients dread the operation; to some it may not be considered wise to administer an anæsthetic; a certain proportion cannot spare from their occupation the time which for safety's sake should be spent in bed. If, then, through electricity, properly applied, these vegetations may be disposed of as effectually as by the curette, the method should commend itself to the practitioner for the class of women above described. It is but fair to state that even though the ultimate result may be the same as that from the curette, the advantage may be claimed for this instrument that one thorough curetting will usually suffice, whilst the electrical treatment will generally be protracted.

It may be emphatically stated that positive intra-uterine galvanization will with fair uniformity destroy the vegetations, and in so far it will check the endometritis. It is essential, however, to cauterize every portion of the endometrium. The positive or active electrode should be, by preference, constructed of platinum; the indifferent pole should be the clay pad or one or another of the substitutes. A current of at least fifty milliampères is requisite, a séance occurring twice a week and the

duration being about five to ten minutes. As soon as the hæmorrhages have been checked, as will be evidenced by the regularity, as regards time and duration, of the menstrual flow, then, where the uterus is heavy and succulent, the quantity faradic current is indicated to complete the cure. Here, as elsewhere, general tonic measures, regulation of the bowels, and due support of the uterus by pessary or tampon in the intervals of treatment, are obviously indicated. The electrical current again appears, according to our view, as a most valuable adjuvant.

In the later stages of hyperplasia, where the uterus is indurated, the discharges are scanty, and the hystero-neurotic phenomena are most marked, the method of using electricity is different. Our aim now is chiefly to cause absorption of, to soften down, the hyperplastic tissue. The indication at the outset is *revulsion.* This may be attained in two ways: 1. Negative intra-uterine galvanization. 2. Negative galvano-puncture.

1. *Negative Intra-uterine Galvanization.*—This method may be resorted to in routine office practice, provided the case is uncomplicated by peri-uterine inflammatory deposit (including under this term disease of the tubes or ovaries). The active pole may be of steel or platinum, and should be inserted *lege artis* to the fundus. The indifferent (positive) pole should be connected with a large abdominal pad. The preference of the writers is for currents of moderate intensity and for séances of about ten minutes in duration. The views of those who advocate high intensities will shortly receive due notice. In our opinion it is not requisite to exceed fifty milliampères, and, on an average, a bi-weekly séance is sufficient. Whenever the scanty menstruation has been replaced by a more profuse (within physiological limits), then the uterus will be found softer, more succulent, and the distressing hystero-neurotic phenomena will have largely been controlled. Now is the time when the tension faradic (vaginal bipolar) current

will be useful in effecting a cure, in so far as this is possible.

The experience of others, it is but fair to state, differs from that which we have recorded. Apostoli may be taken as the type of those who consider higher intensities requisite. He advocates them not alone in the later but also in the earlier stages of hyperplastic endometritis. The determination of the necessity of resorting to these high intensities must be left to the experimenter. Whilst expressing the view that they are not necessary, we reproduce in abstract Apostoli's argument and method, that the practitioner may be in a position to determine the fact himself.

Apostoli's method aims at utilizing to the greatest possible degree the chemical and the trophic action of electricity. He thus exerts a powerful derivatory effect on the uterus. The external electrode which he uses is the clay pad, and it must cover as large a surface as possible, in order to allow the use of great intensities without discomfort or injury to the patient. Apostoli's internal electrode, which he calls the *excitateur intra-utérin*, is in shape and size like the ordinary uterine sound. The handle is constructed of celluloid—a poor conductor of electricity. This handle slips over the electrode proper, so that the surface not in use is thoroughly insulated. The material of which the electrode is made is platinum, and, therefore, it may be used with the positive as well as the negative pole.

In utilizing the chemical galvano-caustic action the different effects of the poles must be ever borne in mind. To insist on them again: The positive pole is called for where the symptoms are chiefly hæmorrhage and leucorrhœa; the negative pole where the discharges are scanty —that is to say, where the uterus is indurated.

At the first séance one hundred milliampères for from three to ten minutes should not be exceeded; later the intensity may extend to two hundred or two hundred and fifty milliampères. After such high intensities the

very just precaution is insisted upon of making the patient rest in bed for a number of hours. The method, therefore, is not applicable to office practice. According to the recent or very chronic nature of the case, the number of séances requisite will vary from three to thirty.

Apostoli, from an experience probably unequalled, claims that the method is safe and does not cause sterility or atresia of the canal. The possible dangers associated with the method are simply those which may follow the introduction of the uterine sound.

2. *Electro-Puncture.*—The treatment of areolar hyperplasia by electro-puncture has been claimed as the most speedy and effective method of all. The value of puncture depends on the utilization of the electrolytic properties of the negative pole. Softening and absorption of the hyperplastic tissue are aimed at. The effect, indeed, is similar to that secured by igni-puncture of the cervix and by the wedge-shaped excision. The advantage it possesses over the latter is that it is in no sense an operation requiring rest in bed. The puncture needle should be of platinum. This is connected with the negative pole of the battery, is plunged into the cervical tissue, and an intensity of about fifty milliampères is to be used. Instead of one needle a number may be utilized, all being connected with the negative pole.

Electro-puncture has been in particular lauded by P. Ménière, of Paris. To judge from reported cases, the method is safe and effective. It is especially adapted to those cases where the uterus is markedly indurated, where the greatest possible revulsive effect is desirable.

UTERINE DISPLACEMENTS AND FLEXIONS—STENOSIS OF THE CERVIX.

Bearing in mind the tonic properties of the electric current, we are naturally led to suppose that in this agent we possess a powerful adjuvant in the treatment of uterine displacements. The symptoms resulting from dis-

placement of the uterus are due almost entirely to the amount of sagging of the organ and the consequent interference with the pelvic circulation. We are speaking now purely of uncomplicated uterine displacement; the question is a very different one when there co-exist peri-uterine adhesions or disease of the tubes or ovaries. Simple uncomplicated displacement causes symptoms,

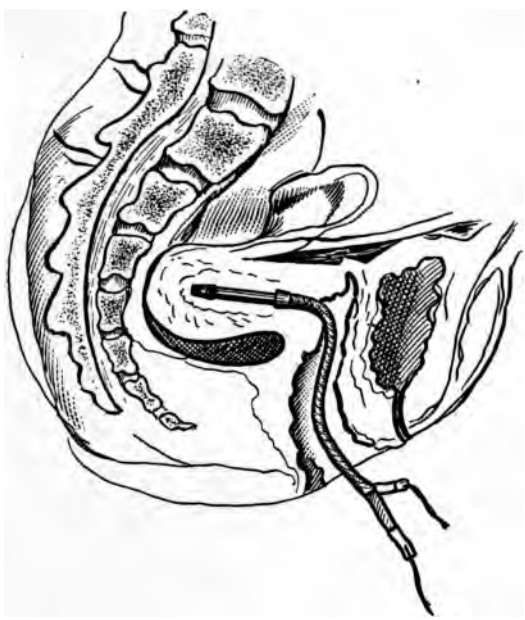


FIG. 43.—Bipolar Uterine Faradization in case of Retroversion.

not on account of the backward or forward inclination of the organ, but on account of the associated descent, whereby traction is exerted on the folds of peritoneum which constitute the so-called uterine ligaments. Now, this sagging, this descent, is invariably due to one or another of two causes: either to pressure or weight from above, or to lack of support from below. Tumors of the uterus, subinvolution and its causal factors, loss of elasticity in the pelvic floor from rupture or separa

of the muscles or fascia—such are the causes of uterine descent, and our aim in treatment should be to cure these factors and thus relieve the symptoms which are due to the descent. Now, given a case of retroversion and descent associated with lesion of the pelvic floor, and the futility of depending on electricity to cure the symptoms is apparent. What is lacking is support from below, and the indications are first to repair the lesion of the pelvic floor, and next we may to advantage utilize the tonic properties of electricity. Again, given an instance of descent associated with fibroid or with subinvolution and endometritis. Here the cause of the symptoms is weight from above, and if through electricity we can obtain decrease in size of the fibroid or lessen the subinvolution, then, of course, we relieve the symptoms. Thus, by strictly differentiating the cause of the uterine displacement, we can select the cases which are suitable for electricity and those which are not. These prefatory remarks have seemed essential because, in their enthusiasm, certain gentlemen have claimed for electricity in the treatment of displacements certain virtues which it does not possess. Electricity is no cure-all. It is useful within certain limits, and no further. This truth must be recognized and cannot be sufficiently emphasized. A further fact to be emphasized is that the use of electricity does not, as has been claimed, enable us to dispense with pessaries. Whilst tone is being restored to the uterine supports through the persistent use of electricity, it is of decided advantage, from the side of relief to the pelvic circulation, to maintain the uterus at a slightly higher level in the pelvis by the fitting of a suitable pessary.

In the face of uterine displacements, then, electricity must be considered a valuable adjuvant, and it remains now to consider the variety of current which is chiefly indicated. In the instances where the current is called for at all, it is the faradic which is likely to yield results. What is lacking is tone, and this is best secured

by the frequent application of the quantity faradic current, by both the vaginal and the bipolar methods. Where associated causal factors are present, these are to be relieved by suitable galvanization—for instance, endometritis and subinvolution call for resort to the therapeutic methods already outlined, and fibroids to those to be referred to *in extenso* further on.

Flexions and Stenosis.—Flexion *per se* does not give rise to symptoms. Flexion with stenosis causes symptoms chiefly on account of the associated cervical endometritis. Dysmenorrhœa, then, accompanying stenosis, is to be cured, if at all, through relief of the endometritis which is the invariable accompaniment of the flexion. The methods of treatment at our disposal are twofold, divulsion and electrolysis. The first method is more rapid than the second, but then it has the disadvantage of being an operation and of entailing the consequent risks. The young unmarried girl, in whom the dysmenorrhœa can be clearly traced to the flexion (it is above all important to differentiate strictly the cause of the dysmenorrhœa), shrinks from an anæsthetic; and if it can be shown her that the careful use of electricity can do her no damage, is not at all dangerous, and will relieve her symptom, she will gladly give the extra time which this slower therapeutic method entails. It must be remembered, however, that the case is not going to be cured through simple overcoming of the stenosis. The associated endometritis must be cured or the case will inevitably relapse.

The method is applicable in one's office. The negative pole of the galvanic battery is to be chosen at the outset as the active pole, and it is to be remembered that caustic effects are to be avoided and that therefore high intensities are contra-indicated. A mean of eight milliampères is all that is necessary. The obstruction is overcome by gradually passing through the internal os—th
flexion—bulbous metallic sounds until
readily enters the uterus. The degr

tained bimanually by the operator. The stem of the bulb is bent to the required degree. The bulb is guided to the external os by the finger in the vagina, the electrode being connected with the negative pole, and the positive electrode being placed on the abdomen. The current is gently turned on until it reaches five to eight milliampères, and in the course of a few minutes the bulb will pass the flexion. Thus gradually increasing sizes are used, and when the requisite amount of dilatation is secured the next step is to cure the endometritis, and this is done by the method which has already been described.

Electrolysis for stenosis is also applicable to cases of sterility. The cervical canal is thus enlarged, the endometritis is cured, and the patient may conceive.

The above method, in our hands, has been wonderfully successful. We may look upon it as one of the very few instances where positive results may be predicated from the use of electricity, provided the case has been properly differentiated as one where the cause of the dysmenorrhœa resides in the stenosis.

MEMBRANOUS DYSMENORRHŒA.

In the treatment of this aggravated and peculiarly distressing affection, caustics to the endometrium and the curette have been the favorite and the prevalent routine measures. As a rule the result is most discouraging. Electricity here, when properly used, offers hope of substantial cure. Resort to this agent should be through the bipolar electrode, using, however, galvanism instead of faradism. Gunning's bipolar electrode, curved, as it may be, to the proper degree, is inserted into the uterus, the negative pole being in the cavity, and the positive resting midway between the external and the internal os. The galvanic current is then turned on to the extent of five milliampères, and the séance lasts for five minutes. Two Leclanché cells will give a current of this intensity, and therefore the gene-

ral practitioner need not possess an elaborate apparatus in order to utilize this method. The effect of this current is to contract the endometrium, to disintegrate the uterine cells, and to paralyze the peripheral nerves. The séance should be repeated twice a week. The general condition of the patient may be improved by resorting to central galvanization in the intervals. The positive electrode (of large surface) should be applied to the

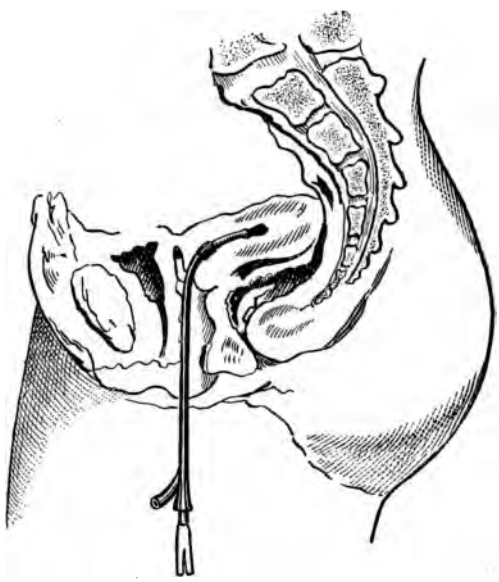


FIG. 44.—Showing Position of Poles in Uterus in case of Bipolar Galvanization.

pit of the stomach, and the negative to the end of the spine. About ten milliampères should be used.

The general effects of bipolar galvanization in membranous dysmenorrhœa are: 1. It softens the mucous membrane. 2. It disintegrates this membrane; the capillaries and small vessels of the membrane become filled with clots, the blood supply being thus shut off. 3. The substance of the membrane is lessened in quantity through the exosmotic and endosmotic effect of the

current. Finally, after the current has resulted in cure of the unhealthy condition of the endometrium, divulsion may be resorted to in order to overcome any existing flexion.

DISEASE OF THE UTERINE APPENDAGES.

Under this term we include the various affections which follow on attacks of cellulitis or pelvic peritonitis —that is to say, those cases where clinically we detect

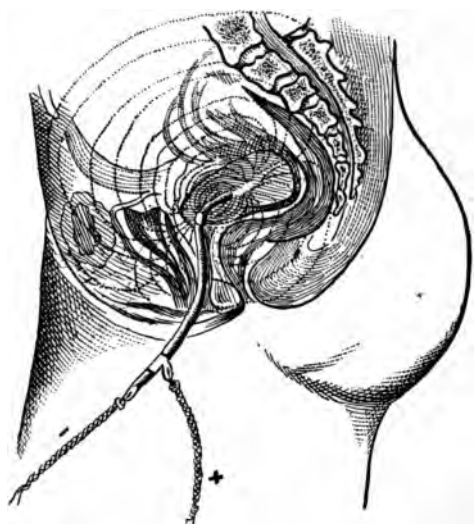


FIG. 45.—Bipolar Galvanization of the Uterus.

thickening around the uterus, in the cellular tissue or uterine ligaments (*chronic cellulitis, chronic pelvic peritonitis*), as also those cases where the ovaries and tubes are surrounded by remnants of exudation (*peri-oöphoritis, peri-salpingitis*), and are to a greater or less degree bound down to the floor of the pelvis. In such instances, whether the primary disease emanated from the uterus or tubes or the ovaries, or not, the condition is certainly aggravated by these so-called thickenings, and it is against these in particular that routine non-surgical

methods of treatment have been directed. It must be confessed that, aside from simple chronic cellulitis, these means (iodine, glycerin tampons, the hot douche, etc.) almost always prove ineffectual, and therefore it is why of late years laparotomy, followed by the loosening of the adhesions and removal of the tubes and of the ovaries, has been so frequently, in the opinion of many too frequently, resorted to. There is to-day no question of greater importance to woman than as to whether, in the instances under consideration, there can be palliation short of laparotomy, especially since it is evident to-day that in no given case can it be asserted that laparotomy with its risk will certainly cure. The importance of this subject warrants detailed consideration ; for if we can show that electricity can palliate as effectively as laparotomy, in the class of cases under consideration, then there will remain no justification for a measure which a not inconsiderable number of gynæcologists are of the opinion has become too much a matter of routine.

At the outset let it be understood that the remarks which follow are not at all applicable to cases where there exists an enlarged tube, probably filled with pus, for here no one questions the justifiability of laparotomy. We are speaking purely of instances where careful examination reveals only thickening of, or in the region of, these organs—that is to say, where, although the symptoms may be as aggravated, there is no ever-present risk of rupture of what may be termed an abscess into the peritoneal cavity. In other words, the results of peritonitis are the main factors we are here concerned with, and to understand the *rationale* of any proposed method of treatment it is necessary to bear in mind the nature of the pathological changes which accompany the condition.

In these chronic inflammatory affections of the uterine adnexa the constant and characteristic symptom is pain, often so intense as to render life unendurable. This pain is largely due to the fact that the essential organs, the

tubes and the ovaries, are included in the remnants of exudation, their function being, furthermore, thus impaired; and, again, the pelvic nervous supply is pressed upon by the same remnants. A further factor uniformly present is pelvic congestion, which, as we have seen, is a frequent source of discomfort, if not of actual pain, to the woman. Notwithstanding these local conditions the women menstruate—that is to say, in accordance with the prevalent view, they ovulate—and therefore, although diseased, these women are not, as is so often stated, incapable of conception, an argument which we frequently hear advanced in justification of a laparotomy which *per se* has sterilized them. The question, indeed, is narrowed down to this: the finding of a method of treatment which will loosen adhesions, cause the absorption of inflammatory remnants, quiet the pain, relieve the local congestion, and at the same time not risk the life of the woman or render her absolutely incapable of procreation. Evidently laparotomy for the removal of the appendages will not satisfy the above aim. Will electricity do so? Be it understood that we are not arguing that there is any method by means of which a *restitutio ad integrum* may be effected; we seek simply for some substitute for the radical operation of extirpation—a substitute, that is to say, which will palliate the local conditions and the symptoms while not unsexing the woman.

A brief recapitulation of the pathological changes which exist in these cases of chronic inflammatory affections of the uterine adnexa will assist us in estimating the probable worth of electricity as a palliative agent. We say palliative, for the reason that in many instances even laparotomy does not do more than this, and therefore we are not justified in speaking of *cure.*

We present the following statement of the changes present in the affections under consideration:

Chronic pelvic cellulitis is indicated by thickening,

induration, and deformity (shrinkage) of the pelvic wall or floor, or broad ligaments.

Chronic pelvic peritonitis is indicated by a superficial thickening, induration, perhaps also shrinkage, of the pelvic peritoneum, with adhesions, cheesy and cretaceous material, or fluid (bloody or serous).

In *chronic pelvic* peritonitis *the tubes* may show little or no change, or they may be shortened, thickened and dense, adherent, dilated or not, with or without contents. *The ovaries* may show no change, or may be indurated, deformed, buried in adhesions, with or without cysts.

In *chronic salpingitis* the tubes are elongated, dilated, varicose, the free end adherent or closed. The walls are thickened, the lining thickened, gray, translucent, the surface smooth or granular. The contents are a watery, yellow, puriform material, with flocculi and cheesy masses. This condition may become a hydro-salpinx.

In *chronic oöphoritis* there is thickening, shrivelling, induration of the ovaries, with or without cheesy or calcareous masses. Adhesions are usually associated ; the tubes need not be simultaneously affected, but may be.

These views teach us a number of things. In the first place, in any given case we are not in a position to state that the tubes or ovaries are altered; these organs may be embedded in adhesions and yet be in themselves in a normal condition. Such being the case—and the laparotomist has himself often proved this by showing us specimens which he has removed, and yet they were normal—the aim of treatment should be to cause the absorption of these masses of exudation and the loosening of the adhesions, and it should not be directed towards the removal of organs which may be impaired in function but still not diseased. In the second place, we learn from the above considerations that the woman's life is not imperilled by the conditions in her pelvis, although her life is often made practically unendurable. It follows, hence, that the treatment should be one which, while palliating her symptoms, will not subject her to

any more risk than she is at the time under. Obviously laparotomy does subject her to risk, and we therefore must seek some method which does not.

Of the routine methods applicable to the treatment of these chronic inflammatory affections of the uterine adnexa, the persistent tamponade, the hot douche, etc., are scarcely effective, or at best but temporarily so, except where the condition is chiefly a chronic cellulitis. Some absorption of the masses of exudation may thus be induced, but where the changes are chiefly around the tubes and the ovaries, where the condition is mainly a chronic pelvic peritonitis, these methods, it is within the experience of all gynæcologists, are not of much benefit, aside from the fact that but few patients are willing to submit to the very protracted treatment necessitated, seeing that we are not able to promise marked and lasting amelioration. *A priori* we should expect speedier and more marked results from electricity, and this is amply proved by a study of the few recorded cases in which this agent has been resorted to. By means of this agent we can unquestionably cause absorption of the inflammatory remnants, and in many instances this is all that is necessary to restore the woman to a state of relative well-being.

There are numbers of cases on record now which amply prove that electricity is a most valuable adjuvant means of treatment in the cases under consideration. These cases also evidence the fact that, in view of the possibility of thus alleviating the general and the local condition of these patients, laparotomy for the removal of the uterine appendages should not be resorted to before electricity has been faithfully tested, excepting, of course, in those instances where the bimanual reveals marked distention of the tube—a distention which the rational history of recurrent attacks of pelvic peritonitis teaches us is due to the presence of pus (pyo-salpingitis). True enough, we cannot speak of cure as the result of using electricity, but the accumulating testimony of individual observers

points to the fact that neither can we predict cure in these chronic inflammatory affections after laparotomy. To quote the words of but a single operator: We are concerned now with the one symptom—pain, as a result of disease of the pelvic organs, exclusive of malignant disease. For the relief of pain supposed to be due, we will say, to ovarian or tubal disease, abdominal section is performed. The organs at fault are successfully removed, and the patient makes a good recovery. It may be a case in which both ovaries and tubes are removed, and, as the disturbing element of menstruation is eliminated, the patient is encouraged to expect a cure. Three months elapse, and still the patient suffers, not from the old dys-

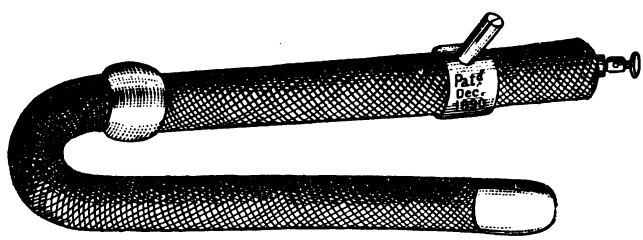


FIG. 46.—Gunning's Bipolar Adjustable-flexible Rectal Electrode.

menorrhœa, but from a pain more or less constant. She is encouraged to wait patiently; but in some cases, which have probably occurred to all of us, time brings no relief, and pains of some kind persist, varying perhaps in degree at different times, but never entirely absent. There are a few cases in which the suffering after operation is even greater than it was before (J. B. Hunter).

It is needless to describe in detail the methods of applying electricity to this class of cases. In general it may be stated that whilst the case is at all acute the physician had best rest satisfied with the results obtainable from vagino-abdominal galvanization and from the bipolar vaginal faradization. In case of chronic affections bipolar intra-uterine faradization and galvanization is strongly indicated and of marked value.

A further method of treatment—which, while we do not indorse it, we must, to be impartial, describe—is electro-puncture, favored in particular by Apostoli. The following are the general rules laid down by him for electro-puncture:

The procedure being a painful one, it is advisable to administer an anæsthetic, although, where the patient is of a phlegmatic temperament and able to bear pain, it is preferable to dispense with anæsthesia, since thus we have the sensations of the patient as a guide in regard to the intensity of the current which we may utilize. This intensity will vary from fifty to two hundred and fifty milliampères, and the séance may be prolonged to ten minutes. The number of séances necessary will vary with the case. Apostoli tells us that one puncture will sometimes suffice in case of a slight parametritis, while in others ten to twelve may be requisite. While, in general, rest in bed after the puncture is preferable, still Apostoli has thus treated a number of cases without compelling them to desist from their usual avocations. Before resorting to puncture it is essential by careful examination to choose a site where there is no pulsation, and by preference the most projecting portion of the exudation. The depth of the puncture should be about one centimetre, hardly more, for fear of injuring the peritoneum; perfect antisepsis should accompany it; at the termination of the séance the vagina should be tamponed with iodoform gauze. As the result of the puncture an eschar is induced, which separates about the eighth day, and a sinus is left whence derivation is procured. This sinus will remain open, according to its depth and extent, for from fifteen to eighty days, and as long as it remains the tamponing with iodoform gauze must be continued.

Such, in outline, is the method which Apostoli has practised and from which he claims excellent results.

In weighing the evidence at our disposal, and for the present limiting our remarks purely to chronic cases,

the assertion appears warrantable that in electricity we possess a most valuable adjuvant method of treatment of the stubborn affections under consideration, and that, in justice to his patients and to his specialty, the gynæcologist is in duty bound to test it faithfully and intelligently before resorting to laparotomy, which operation should be made the strict *dernier ressort*, except where the physical examination gives unmistakable evidence of the presence of a tumor, from the discharge of the contents of which into the peritoneal cavity a peritonitis may be predicated. To make one of these suffering women comfortable, if not to entirely cure her, by means of electricity, redounds more to the credit of the gynæcologist than if he sterilizes her and still does not cure her. There is certainly ground for hopefulness that in the treatment of these chronic inflammatory affections of the uterine adnexa, electricity will find one of its chief fields of usefulness.

ECTOPIC GESTATION.

The earliest record of resort to electricity for the purpose of destroying the fœtus developing outside of the uterus is in the year 1853, when Bachetti and Burci used electro-puncture with the faradic current and successfully arrested gestation in the left Fallopian tube. About thirteen years later Braxton Hicks tested faradization in a case of abdominal pregnancy of three and a half months' duration, then resorted to puncture of the cyst *per vaginam*, and the patient died a few days later from internal hæmorrhage. In 1869 Allen, of Philadelphia, resorted to faradization in a case of abdominal pregnancy at the fourth month with success, and since this date the method may be said to have gradually gained ground, until to-day it has become an accepted procedure in instances of early ectopic gestation. It should be stated, however, that resort to electricity in this connection has remained almost entirely limited to this country. European obstetricians, with the exception of a few English,

have held aloof from the method, preferring that by puncture of the cyst or the injection of narcotics, or latterly the very radical means of laparotomy for the removal of the sac (Veit, Tait, Martin, and others). In this country, however, instances have multiplied so rapidly that in the neighborhood of one hundred are now on record where electricity has been used with success in ectopic gestation, and at one time or another our most distinguished obstetricians have expressed their belief that it is the safest of all methods of treatment applicable to the anomaly in its early stages. The method, indeed, would need no defence, and at this date no lengthy exposition, were it not that latterly, owing to the strong operative tendency of the times, there appears to be a desire to substitute laparotomy for it—a substitution for which, it seems to us, in face of the recorded successes from electricity and the greater risk of laparotomy, there is no justification. Thomas, of New York, who has had such an exceptionally large experience in cases of extra-uterine pregnancy, states: "The growing triumphs of abdominal surgery are apt to lead to the conviction that laparotomy should, as a rule, be the procedure of election in these cases. From this view I unqualifiedly dissent. In the electric current we appear to have an infanticide agent of reliable character; and as in the woman, as Leopold has proved to be the case in the rabbit, the retained fœtus seems to be readily dealt with by the absorbent process of nature, this should be, in the early months of pregnancy (I should say up to the fifth month), preferred to the more radical and dangerous procedure of laparotomy." In another paper the same gentleman says: "It (electricity) has these great advantages: if an error of diagnosis has been made, this remedy will do no harm; if the diagnosis be correct, experience proves it to be sufficient in its effect; it is almost painless, and causes none of the nervous disturbances created by a cutting operation, and it requires no surgical skill in its use."

The objections which have been urged against resort to electricity are two in number. In the first place, there is liability to rupture of the cyst, and, in the second place, we kill the fœtus and then leave it within the maternal abdomen, where it may at any time suppurate and give rise to septicæmia. Both of these objections are purely theoretical, seeing that in the large number of cases in which electricity has been resorted to rupture of the sac has never occurred, nor, so far as we can find any reference, has the dead fœtus become a source of danger to the mother.

The alternative method of treatment proposed is primary laparotomy. The advocates of this method base their objections to electricity on the score, first, that the diagnosis is obscure, and that therefore an exploratory laparotomy is indicated; secondly, on the score that electricity cannot kill the fœtus, or, if it does, that the placenta continues to grow and will prove a source of future danger to the child. Certain enthusiastic laparotomists of the younger school contend that the instances which have been recorded as cures of ectopic gestation through the application of electricity were cases of erroneous diagnosis. Aside from the gratuitous nature of an assumption which casts a doubt on the diagnostic ability of some of the most eminent men in the profession, we may fairly ask: Given a history of amenorrhœa in a patient previously regular, associated with the rational signs of pregnancy—colicky pains in the abdomen, irregular discharges, passage of a decidua, the presence of a tumor—electricity is applied and the tumor disappears, together with the other abnormal phenomena; now, what condition was present, if not an ectopic gestation? A pelvic exudation, a fibroid of the uterus or ovary—surely a few applications of electricity are not able to cause the disappearance of such conditions. Without dwelling further on this argument, the best way to dispose of the other objections to the method is to analyze the reported instances of cures by electricity, with the end in view of

No.	Case of.	Seen by.	Reported in.	No. of applications.	Variety of current.	Remarks.
1	Bachetti...	Burci, Bartolini, and Torri.	Gaz. Medic. Italian. Federat. Toscana, 1853, vol. iii., No. 18; L'Union Méd., 1857, xi.; Trans. Am. Gyn. Soc., 1882, p. 191.	1	Electro-puncture with faradism.	3 months' growth; tubal gestation; three months later the tumor was reduced to the size of a pigeon's egg.
2	Hicks.....	. .....	Trans. Obst. Soc. London, 1866, vol. vii.; Parry, "Extra-uterine Pregnancy"; Trans. Am. Gyn. Soc., 1882.	2	Faradism	3½ months' growth; abdominal gestation; two applications in ten days under chloroform and causing temporary cessation of the fœtal movements; five weeks later, puncture of the cyst through the vagina, followed by internal hæmorrhage and death.
3	Allen.....	. .... .	Trans. Obst. Soc. Phila., 1872; Am. Journ. of Obst., 1872; Trans. Am. Gyn. Soc., 1882.	8	Faradism	4 months' growth; abdominal pregnancy; three years later a tumor left, the size of a fist.
4	Allen.....	Agnew & Pepper.	Journ. of Obst., 1872, vol. v.	.....	Faradism	10 weeks' growth; the tumor was later found reduced to the size of a goose egg.
5	Landis....	Loving.	Ohio Med and Surg. Journ., Oct, 1877.	8	Faradism	2½ months' growth; tubo-abdominal gestation; no trace of tumor left in less than a year.
6	McBurney.	Rockwell, Thomas, & Emmet.	N.Y. Med. Journ., Mar, 1878; Trans. Am. Gyn. Soc. 1881; Beard and Rockwell, "Med. and Surg. Electricity."	2	Galvanism	3 months' growth; tubo-uterine gestation; after the second application, contractions were set up in the tumor and the fœtus was discharged through the uterus and vagina.
7	Reeve.....	.....	Trans. Am. Gyn. Soc., 1879.	13	Faradism	3 months' growth; abdominal gestation; six months later the tumor was quite small.
8	Harrison..	Thomas...	Trans. Am. Gyn. Soc., 1882.	3 or 4	Faradism	3 months' growth; tubal gestation; tumor steadily diminished.
9	Lusk	Keyes	Journ. of Obstetrics, April, 1881.	3 or 4	Faradism	3 months' growth; tubal gestation; tumor was found, some time after, reduced to the size of an English walnut.
10	Wilson....	....	Trans. Am. Gyn. Soc., 1882; Journ. of Obst., Sept., 1882.	6 or 8	Faradism	2½ months' growth; the tumor began to diminish after a week's treatment, and finally disappeared.

11	Landis....	Dunlap...	Med. News, Aug. 8th, 1882; Mundé in appendix to Caseaux and Tarnier's "Obstetrics" (7th Am. Ed. 1884).	6	Faradism	8 months' growth; same patient as Case No. 5, seen four years later; tubal gestation; tumor steadily diminished in size.
12	Billington.	Thomas & Rockwell.	Trans. Am. Gyn. Soc., 1882; Journ. of Obst., 1881; Beard and Rockwell (loc. cit.).	4	Galvanism	8 months' growth; tubal gestation; complete recovery.
13	[illegible] Mc. K. Emmet.	T. A. Emmet, Thomas, & Rockwell.	Journ. of Obst., Feb., 1882.	8	Galvanism	8½ months' growth; abdominal gestation; finger in uterine cavity found it empty, tumor diminished in size.
14	[illegible]	Schiller...	Journ. of Obst., Sept., 1882; Trans. Am Gyn. Soc., 1882;	10	Faradism	2 months' growth; tubal gestation; after seven days reduced to size of English walnut.
15	[illegible]	Thomas, Emmet, & Rockwell.	Trans. Am. Gyn. Soc., 1882; Beard & Rockwell (loc. cit.)	4	Galvanism	8½ months' growth; extra-uterine mass steadily diminished in size.
16	[illegible]	Thomas & Rockwell.	Beard and Rockwell (loc. cit.).	4	Galvanism	6 weeks' growth; tubal gestation was probably associated with normal pregnancy; the normal pregnancy was not disturbed; the extra-uterine mass was later barely to be detected.
17	[illegible]	Rockwell.	Beard and Rockwell (loc. cit.).	3	Galvanism	4 months' growth; no evidences of tumor to be found after a time.
18	[illegible]	Emmet & Rockwell.	Beard and Rockwell (loc. cit.).	4	Galvanism	3 months' growth; the patient was entirely cured.
19	[illegible]	[illegible]	Trans. Am. Gyn. Soc., 1884.	10	Faradism	2½ months' growth; abdominal following ruptured tubal gestation.
20	[illegible]	[illegible] & [illegible]	Trans. Am. Gyn. Soc., 1884; Journ. of Obst., Oct., 1884.	12	Faradism and Galvanism.	3 months' growth; tumor became very much smaller; slight thickening left after four months.
21	[illegible]	[illegible] & [illegible]	Trans. Am. Gyn. Soc., 1884; Journ. of Obst., Oct., 1884.	4	Galvanism	4½ months' growth; abdominal gestation; reduced to the size of a hen's egg.

No.	Case of.	Seen by.	Reported in.	No. of applications.	Variety of current.	Remarks.
22	Mundé....	Emmet....	Journ. of Obst., Oct., 1884.	7	Galvanism and Faradism.	After first application of galvanism patient went into collapse; sixteen days later faradic current substituted; tumor reduced one-third in size. Well two years later.
23	Berlin	Chadwick and West.	Boston Med. and Surg. Journ., Sept,, 1884.	6	Galvanism	4 months' growth; only a small portion of mass left five months later.
24	Sibbald...	....	Polyclin., 1884, No. 15; Centralbl. f. Gyn., 1885, p. 288.	11	Galvanism	3 months' growth; diminution in size of tumor.
25	Briggs.....	Mann.....	Med. News, July 11th, 1885..	13	Faradism	3 months' growth; tubal gestation; tumor became very much smaller.
26	Stoddard..	Mann.....	Med. News, July 11th, 1885..	3	Faradism	3 months' growth; tubal gestation; only trace of tumor left.
27	Lusk.....	Thomas...	Journ. of Obst., Aug., 1885..	14	Faradism	3 to 4 months' growth; tubal gestation; considerable decrease in size of tumor.
28	Garrigues.	Colles	Med. News, Dec. 12th, 1885..	8	Faradism	3 months' growth; fœtus not killed, but expelled into uterine cavity, where it continued to develop up to the eighth month, when it was born alive and lived five hours; interstitial growth.
29	Lusk.....	R.H.Sayre	Med. Record, Jan. 23d, 1886.	4	Faradism	8 months' growth (?); severe inflammation set up in the sac, probably due to previous puncture with aspirating needle; discharge of fœtus and removal of placenta through vaginal rent; almost fatal.
30	Goelet...	Rockwell and Lee.	Med. Record, June 26th, 1886.	.....	Galvanism	Successful termination.
31	Aveling...	Spencer Wells.	Brit. Med. Journ., Dec. 4th, 1886.	4	Faradism	3 months' growth; tubal gestation; only a little thickening left.
32	Gardiner..	.....	Brit. Med. Journ., Dec. 4th, 1886.	6	Faradism	4 months' growth; success.

33	Janvrin...	Rockwell..	Trans. Am. Gyn. Soc., vol. xi.	3	Galvanism	6	weeks' growth; after third application internal hæmorrhage; death; at autopsy sac ruptured.
34	Petch.....	... .	Brit. Med. Journ., Dec. 4th, 1886.	1	Galvano-puncture	5	to 6 months' growth; tumor three years after had entirely disappeared.
35	Hockmann	Freund....	Ed. Med. Journ., Nov., 1883.	1	Static	6	months' growth; marked shrinking of tumor; death of fœtus.
36	Trush	Palmer....	Journ. of Obst., Dec., 1886	21	Faradism	3	to 3½ months' growth; interstitial; fœtus expelled into uterine cavity, thence delivered.
37	Van de Warker.	Mann.....	Am. Gyn. Soc., vol. xii.....	13	Faradism	10	weeks' growth; in seven months all trace had disappeared.
38	Sims.	.....	Annals of Gyn., Jan., 1888...	8 to 10	Galvanism	Success.	
39	Chadwick.	Lyman, Fitz, etc.	Am. Gyn. Soc., vol. xii.....	24	Galvanism	5	months' growth; ulceration *per vaginam* in two months; recovery.
40	Mann.....	.....	Med. News, July 11th, 1885..	.....	.....	3	months' growth; abdominal (?); tumor reduced to size of an egg.
41	Page.....	Harrison..	Journ. of Obst., April, 1887..	5	Galvanism	2	months' growth; success.
42	Harrison..	Page.....	Journ. of Obst., April, 1887..	.....	Galvanism	3	months' growth; success.
43	Brothers..	Huber and Denhard.	Journ. of Obst., May, 1888 ..	8	Faradism	2½	months' growth; interstitial; after several months mass had disappeared.

determining if the safety to the patient is mediately or remotely imperilled through resort to it. The table, on pages 90–93, of forty-three cases collated by Brothers, of New York City, may be studied to advantage.

"From this list we see that, of the forty-three cases, two were treated by electro-puncture, twenty-one by faradism, sixteen by galvanism, two by both currents, and one by franklinism; in the remaining case either faradism or galvanism was used, but the reporter does not specify which. Two cases terminated fatally: the case of Braxton Hicks, as the result of subsequent puncture of the cyst five weeks later, and hence the fatal result cannot be attributed to the electricity; and the case of Janvrin, in which hæmorrhage was induced from a ruptured artery on the sac wall, which had spontaneously opened nine days previously. In this case Janvrin acknowledges that, in view of the probable internal hæmorrhage, laparotomy should have been resorted to in the first instance. In the cases of Mundé, Lusk, Gardiner, and Chadwick alarming symptoms developed for a time, but the patients recovered. In all of the cases excepting two the fœtus was killed. Of these two, in the case of Hicks the method was abandoned after two trials; and in the case of Garrigues the fœtus was displaced from the tube into the uterus, where it continued to grow. In more than half of the cases it is distinctly stated that the tumor either entirely disappeared or became shrivelled up into a small mass. In the cases of McBurney, Garrigues, and Trush the current set up contractions in the muscular layer of the Fallopian tube, which resulted in the expulsion of the fœtus into the uterine cavity. In the cases of Lusk and Chadwick the treatment was followed by suppuration in the sac and septicæmia; the fœtus in each case began to work its way through a spontaneous opening in the vagina, and both patients recovered."

From Brothers' analysis it may be positively stated that twenty-five cases (reported cured) have been heard

from after a lapse of from one to eight years, and that when last seen all were reported well. Many of them still carried traces of the old trouble, and it would be unfair to assert that these little masses could in the course of time never become troublesome; still, the fact remains that, as far as we have been able to discover, they have up to the present caused no inconvenience.

The great importance of reaching a definite conclusion in regard to the propriety of using electricity in ectopic gestation is our excuse for interpolating here the opinions, recently expressed, of a number of gentlemen whose names carry weight.

Matthew D. Mann, of Buffalo, says: It seems to me, then, in the light of what we know regarding the natural history of ectopic gestation, and in the light of experience up to to-day, that we ought to advocate and to practise electrical fœticide in most cases during the first four months of extra-uterine gestation and before symptoms of rupture into the abdomen have occurred. For I think a lot of fanciful and theoretical objections have been raised which are not warranted by experience or the facts. Much has been made of a few mistakes, and cases have been distorted and made to act as arguments which ought never to have been so used. What if somebody has made an error and mistaken a cyst of the Fallopian tube for a tubal pregnancy; is that an argument to be used as against the possibility of ever making a right diagnosis, in view of the fact that we have incontestable evidence that other men of no greater experience have a number of times correctly diagnosed these cases? Are all the cases to be set aside as mistakes because one man has been falsely accused of making a mistake? Certainly such a judgment would be unfair and would not be treating the matter with the true scientific spirit. Just as well say that, because our very best diagnosticians have mistaken a pleurisy for a pneumonia, all diagnoses of pneumonia are failures, and this in view of the abundant testimony of the dead-house.

No.	Case of.	Seen by.	Reported in.	No. of applications.	Variety of current.	Remarks.
1	Bachetti...	Burci, Bartolini, and Torri.	Gaz. Medic. Italian. Federat. Toscana, 1853, vol. iii., No. 18; L'Union Méd., 1857, xi.; Trans. Am. Gyn. Soc., 1882, p. 191.	1	Electro-puncture with faradism.	3 months' growth; tubal gestation; three months later the tumor was reduced to the size of a pigeon's egg.
2	Hicks.....	. .....	Trans. Obst. Soc. London, 1866, vol. vii.; Parry, "Extra-uterine Pregnancy"; Trans. Am. Gyn. Soc., 1882.	2	Faradism	3½ months' growth; abdominal gestation; two applications in ten days under chloroform and causing temporary cessation of the fœtal movements; five weeks later, puncture of the cyst through the vagina, followed by internal hæmorrhage and death.
3	Allen.....	. ...	Trans. Obst. Soc. Phila., 1872; Am. Journ. of Obst., 1872; Trans. Am. Gyn. Soc., 1882.	8	Faradism	4 months' growth; abdominal pregnancy; three years later a tumor left, the size of a fist.
4	Allen.....	Agnew & Pepper.	Journ. of Obst., 1872, vol. v.	.....	Faradism	10 weeks' growth; the tumor was later found reduced to the size of a goose egg.
5	Landis....	Loving.	Ohio Med and Surg. Journ., Oct, 1877.	8	Faradism	2½ months' growth; tubo-abdominal gestation; no trace of tumor left in less than a year.
6	McBurney.	Rockwell, Thomas, & Emmet.	N.Y. Med. Journ., Mar, 1878; Trans. Am. Gyn. Soc., 1881; Beard and Rockwell, "Med. and Surg. Electricity."	2	Galvanism	3 months' growth; tubo-uterine gestation; after the second application, contractions were set up in the tumor and the fœtus was discharged through the uterus and vagina.
7	Reeve.....	.....	Trans. Am. Gyn. Soc., 1879.	13	Faradism	3 months' growth; abdominal gestation; six months later the tumor was quite small.
8	Harrison..	Thomas...	Trans. Am. Gyn. Soc., 1882.	3 or 4	Faradism	3 months' growth; tubal gestation; tumor steadily diminished.
9	Lusk	Keyes	Journ. of Obstetrics, April, 1881.	3 or 4	Faradism	3 months' growth; tubal gestation; tumor was found, some time after, reduced to the size of an English walnut.
10	Wilson....	....	Trans. Am. Gyn. Soc., 1882; Journ. of Obst., Sept., 1882.	6 or 8	Faradism	2½ months' growth; the tumor began to diminish after a week's treatment, and finally disappeared.

11	Landis....	Dunlap...	Med. News, Aug. 8th, 1882; Mundé in appendix to Cazeaux and Tarnier's "Obstetrics" (7th Am. Ed. 1884).	6	Faradism	8 months' growth; same patient as Case No. 5, seen four years later; tubal gestation; tumor steadily diminished in size.
12	Billington.	Thomas & Rockwell.	Trans. Am. Gyn. Soc., 1882; Journ. of Obst., 1881; Beard and Rockwell (loc. cit.).	4	Galvanism	3 months' growth; tubal gestation; complete recovery.
13	Bache McE. Emmet.	T. A. Emmet, Thomas, & Rockwell.	Journ. of Obst., Feb., 1882.	3	Galvanism	3½ months' growth; abdominal gestation; finger in uterine cavity found it empty, tumor diminished in size.
14	Garrigues.	Schüller...	Journ. of Obst., Sept., 1882; Trans. Am. Gyn. Soc., 1882;	10	Faradism	2 months' growth; tubal gestation; after seven days reduced to size of English walnut.
15	Herrick...	Thomas, Emmet, & Rockwell.	Trans. Am. Gyn. Soc., 1882; Beard & Rockwell (loc. cit.)	4	Galvanism	3½ months' growth; extra-uterine mass steadily diminished in size.
16	Westcott..	Thomas & Rockwell.	Beard and Rockwell (loc. cit.).	4	Galvanism	6 weeks' growth; tubal gestation was probably associated with normal pregnancy; the normal pregnancy was not disturbed; the extra-uterine mass was later barely to be detected.
17	Doctor's name suppressed.	Rockwell.	Beard and Rockwell (loc. cit.).	2	Galvanism	4 months' growth; no evidences of tumor to be found after a time.
18	Sims.....	Emmet & Rockwell.	Beard and Rockwell (loc. cit.).	4	Galvanism	3 months' growth; the patient was entirely cured.
19	Cushier...	Thomas. .	Trans. Am. Gyn. Soc., 1884.	10	Faradism	2½ months' growth; abdominal following ruptured tubal gestation.
20	Cocks.....	McCosh & Thomas.	Trans. Am. Gyn. Soc., 1884; Journ. of Obst., Oct., 1884.	12	Faradism and Galvanism.	3 months' growth; tumor became very much smaller; slight thickening left after four months.
21	Lambert..	Jones, Barker, and Thomas.	Trans. Am. Gyn. Soc., 1884; Journ. of Obst., Oct., 1884.	4	Galvanism	4½ months' growth; abdominal gestation; reduced to the size of a hen's egg.

No.	Case of.	Seen by.	Reported in.	No. of applications.	Variety of current.	Remarks.
22	Mundé....	Emmet....	Journ. of Obst., Oct., 1884.	7	Galvanism and Faradism.	After first application of galvanism patient went into collapse; sixteen days later faradic current substituted; tumor reduced one-third in size. Well two years later.
23	Berlin	Chadwick and West.	Boston Med. and Surg. Journ., Sept,, 1884.	6	Galvanism	4 months' growth; only a small portion of mass left five months later.
24	Sibbald...	....	Polyclin., 1884, No. 15; Centralbl. f. Gyn., 1885, p. 288.	11	Galvanism	3 months' growth; diminution in size of tumor.
25	Briggs.....	Mann.....	Med. News, July 11th, 1885..	13	Faradism	3 months' growth; tubal gestation; tumor became very much smaller.
26	Stoddard..	Mann.....	Med. News, July 11th, 1885..	3	Faradism	3 months' growth; tubal gestation; only trace of tumor left.
27	Lusk.....	Thomas...	Journ. of Obst., Aug., 1885..	14	Faradism	3 to 4 months' growth; tubal gestation; considerable decrease in size of tumor.
28	Garrigues.	Colles	Med. News, Dec. 12th, 1885..	8	Faradism	3 months' growth; fœtus not killed, but expelled into uterine cavity, where it continued to develop up to the eighth month, when it was born alive and lived five hours; interstitial growth.
29	Lusk.....	R.H.Sayre	Med. Record, Jan. 23d, 1886.	4	Faradism	8 months' growth (?); severe inflammation set up in the sac, probably due to previous puncture with aspirating needle; discharge of fœtus and removal of placenta through vaginal rent; almost fatal.
30	Goelet...	Rockwell and Lee.	Med. Record, June 26th, 1886.	.....	Galvanism	Successful termination.
31	Aveling...	Spencer Wells.	Brit. Med. Journ., Dec. 4th, 1886.	4	Faradism	3 months' growth; tubal gestation; only a little thickening left.
32	Gardiner..	.....	Brit. Med. Journ., Dec. 4th, 1886.	6	Faradism	4 months' growth; success.

33	Janvrin...	Rockwell..	Trans. Am. Gyn. Soc., vol. xi.	3	Galvanism	6	weeks' growth; after third application internal hæmorrhage; death; at autopsy sac ruptured.
34	Petch.....	... .	Brit. Med. Journ., Dec. 4th, 1886.	1	Galvano-puncture	5	to 6 months' growth; tumor three years after had entirely disappeared.
35	Hockmann	Freund....	Ed. Med. Journ., Nov., 1883.	1	Static	6	months' growth; marked shrinking of tumor; death of fœtus.
36	Trush	Palmer....	Journ. of Obst., Dec., 1886	21	Faradism	3	to 3½ months' growth; interstitial; fœtus expelled into uterine cavity, thence delivered.
37	Van de Warker.	Mann.....	Am. Gyn. Soc., vol. xii.....	13	Faradism	10	weeks' growth; in seven months all trace had disappeared.
38	Sims.	.....	Annals of Gyn., Jan., 1888...	8 to 10	Galvanism	Success.	
39	Chadwick.	Lyman, Fitz, etc.	Am. Gyn. Soc., vol. xii.....	24	Galvanism	5	months' growth; ulceration *per vaginam* in two months; recovery.
40	Mann.....	.....	Med. News, July 11th, 1885..	.....	.....	3	months' growth; abdominal (?); tumor reduced to size of an egg.
41	Page.....	Harrison..	Journ. of Obst., April, 1887..	5	Galvanism	2	months' growth; success.
42	Harrison..	Page.....	Journ. of Obst., April, 1887..	.....	Galvanism	3	months' growth; success.
43	Brothers..	Huber and Denhard.	Journ. of Obst., May, 1888 ..	8	Faradism	2½	months' growth; interstitial; after several months mass had disappeared.

CHAPTER III.

ELECTROLYSIS.

ALTHOUGH, in connection with certain of the subjects already spoken of, we have in truth dealt with electrolytic phenomena, it yet seems proper to consider this subject separately in its application chiefly to fibroid tumors, ovarian tumors, and cancer.

Electrolysis is thus defined by Shaw: It is an electrochemical decomposition, having the power of separating molecules of matter, such as metals, fluids, and some compound substances. The results of the decomposition are termed electrolytes. The positive pole furnishes the *anions* and the negative pole the *cations*. In order to obtain the results of electrolysis from a given agent, this agent must be of such a nature as is not easily acted upon—such as platinum. Therefore why this agent constitutes the preferable one for the construction of electrodes where electrolysis is aimed at. When we connect needles with the poles of a galvanic battery and plunge them into a tumor, we obtain first a *decomposition* of its fluid constituents; secondly, absorption; thirdly, retrograde metamorphosis and atrophy. This may be readily proved outside the body by inserting needles into a piece of beef, and analogically the same result is supposed to follow when morbid growths within or on the surface of the body are similarly treated.

We may demonstrate the catalytic action of electricity by the following experiment:

Take an Axo cell jar (or any one that may be at hand), place into the jar a porous cup, fill the jar up to one of the water-line marks in Axo jar, then pour water into the

porous cup within the jar until it rests on a level with the water outside, so the water will be on a level in each jar. Then introduce an electrode, in the manner shown in the figure, marked with + sign, positive pole, into the water of the jar. Place another electrode into the porous cup, like the one represented in the plate marked — sign, negative pole, suspended there in the position indicated. Make a connection with the battery having the milliampèremeter in the circuit. Then turn on the current until ten milliampères are indicated; let the current

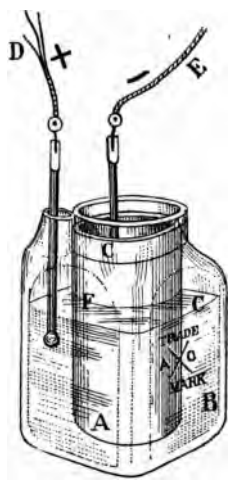


FIG. 47.—Illustrating Catalytic Action of Electricity.

flow for twenty-five minutes, cut off the current and examine, and there will be found a difference of five-eighths of an inch between the water in porous cup and jar, showing conclusively that it does induce osmosis. If electricity will produce an effect like that through such a medium as the clay of a porous cup, how much more it must do this when it is assisted by the process of life!

For the purpose of obtaining electrolytic effects, a galvanic battery arranged for quantity rather than for intensity is preferred by Cutter; other observers do not

lay so much stress on this question of quantity as obtained through large elements. Beard and Rockwell state: For purposes of electrolysis, tension with moderate or fair quantity is required, such as is obtained by a considerable number of elements of medium size. Bartholow also lays rather more stress on intensity than on

FIG. 48.—Conductor for Electrolysis.

quantity. He says: The zinc-carbon combination of Stöhrer for portable use is well adapted for electrolysis, the number of elements used not more than twenty, as the electro-motive force required will not exceed the power of this combination. It is held by some of the most experienced operators (Anderson, Duncan, and Alt-

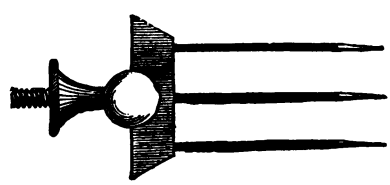


FIG. 49.—Needles for Electrolysis.

haus) that heating power must also be regarded, and hence the larger cells of Stöhrer are recommended; but this statement cannot be accepted without qualification.

Amory, in his recent treatise on electrolysis, says: It is assumed that the electrolytical action is due to interference with cell proliferation; if, then, the current

should be too strong to effect this interference and should excite an inflammation, suppuration will ensue and the action of the electricity as a caustic may be localized upon the parts of the tissue immediately in contact with the electrodes. The products of suppuration prevent the transfer of the electrical action to any distance from the point of application. The effect of a localized inflamma-

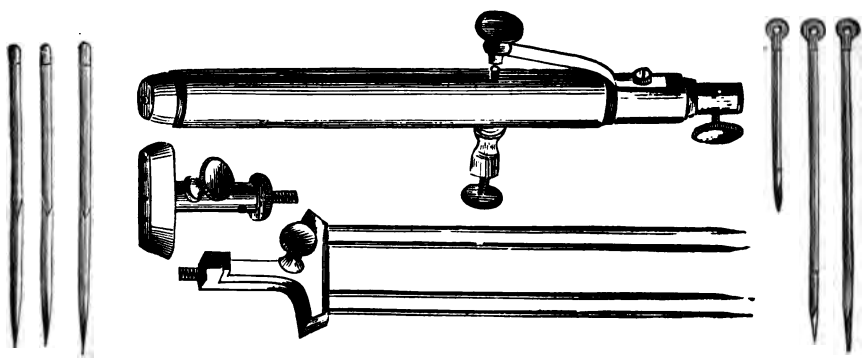


FIG. 50.—Needles for Electrolysis, with Rockwell's Needle Holders.

tion in the tissue surrounding a tumor causes the attraction of a larger amount of blood than will suffice for the simple nutrition of the tumor. Consequently, as there is an increased amount of nutritive material, the tumor has the tendency to grow larger. For these reasons the strength of the current required to effect the slow ab-

FIG. 51.—Rockwell's Long Needle for Puncture through the Vagina or Abdominal Wall.

sorption of tumors should have a feeble tension and small chemical action, and the duration of each sitting should be prolonged.

From these divergent views, sufficient the statement for the general practitioner that experience has amply proven the sufficiency of a number of Leclanché elements for the electrolytic treatment of morbid growths. The point

to be insisted upon nowadays is the placing in the circuit of both the current regulator and the milliampèremeter. We are thus able to gradually increase the intensity of the current as well as to accurately note the amount registered.

Where puncture of tumors is the method preferred, the needles should be constructed of platinum or of gold, insulated to within one-third to one-quarter of an inch of the tip. We figure on pages 102 and 103 a number of suitable needles.

We will proceed now to describe somewhat in detail the various methods which have been proposed for the electrolysis of

FIBROID TUMORS.

Cutter's Method.—Cutter was one of the first to attempt electrolysis in cases of myomata. His first case was treated in 1871. He used as his needle the stylet of a trocar, connected this with the carbon plates of his battery, and plunged it into the tumor, which presented in the posterior vaginal cul-de-sac. His external electrode consisted of a wet sponge, connected with the zinc plates, and placed over the symphysis of the pubes. The patient was anæsthetized and the current was passed for about ten minutes. The second application was made in August by Gilman Kimball, who punctured with a steel stylet. The patient refused further treatment.

The instruments and battery he used in his second and other cases he thus describes: An ordinary surgeon's director is sharpened at the point and edges, an ebony handle is adapted to it, and two inches of the larger end are japanned for insulation. The dimensions are as follows: Length of instrument over all, eight and one-half inches; of blade, four and seven-eighth inches; width of blade at widest part, three-eighths of an inch. The angle made by the two wings of the blade may be represented in section by the letter V. The point of the angle is made dull. The effect of this arrangement is to draw the tissues over the sharp edges represented by the free ends of

the letter V. and thus to cause a ready section of the tissues penetrated. It is evident, also, that the union of the two blades at this angle offers a great resistance to bending in any direction. The patient is anæsthetized and these electrodes are inserted deep into the tumor. The point of insertion depends on the location of the tumor. If unilobar and in the cavity of the abdomen, one electrode is passed through the skin in on one side of

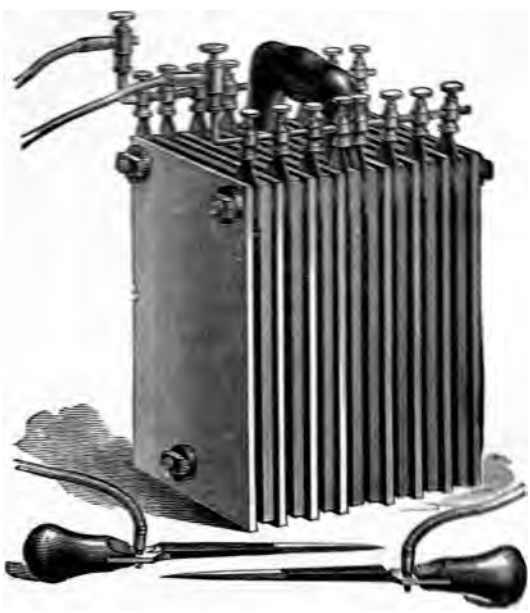


FIG. 52.—Battery and Electrodes used by Cutter.

the tumor, and the other in on the other side of the tumor. Or if the lobe or tumor is small, one electrode may be passed under the other at a distance of half an inch. If the tumor occupies the cavity of the pelvis and has several lobes in the abdomen, one electrode may be pushed in from the rectum or from the vagina, and the other electrode may be passed in through the abdominal walls. If the fibroid is confined to the pelvis, both electrodes are to

be introduced through the rectum or vagina. Care should be taken to avoid any strongly pulsating vessel. In Cutter's reported series of cases the applications varied from three to fifteen minutes in duration, and the best results were obtained after the shorter interval. The length of time was adjudged from the systemic symptoms. If the pulse became accelerated, the respiration hurried, the face pinched, the countenance hippocratic, and the skin sweaty and cold, it was thought time to stop. Etherization masks these symptoms somewhat, and should be allowed for—that is, not to push the time too far. The first operation should be short, and, if well borne, the time may be increased in future operations. The applications were repeated once a week, or every fortnight, in certain instances every day. The after-treatment consisted in confining the patient to bed for a few days.

Cutter's battery is of the Stöhrer pattern, consisting of eight plates of carbon nine by six inches, and of eight plates of zinc nine by six inches. The carbons are one-quarter of an inch thick, and the zincs one-eighth. The zincs are arranged on the outside in the series. The solution is the potassic bichromate in sulphuric acid (one part to eight). What he aimed at was quantity of current, and not intensity.

Up to 1887 Cutter had treated by this method fifty cases with the following results: non-arrests, seven; deaths, four; arrests, twenty-five; relieved, three; absolute cures, eleven. The deaths were due: in one, asthenic type of typhoid; in another, the result of unnecessary exposure in a cold room; in a third, typhoid; in a fourth, in a morphine eater, after the third operation.

In Cutter's latest report on his cases he says: Remember most of the cases operated on were of fibroids, large, hard, extra-uterine and intra-uterine, packing the pelvis, filling the abdomen, occurring in cases of bad general health and complications such as abscesses, ovarian tumors, opium eaters, etc. The worst cases received the operation as well as the most promising.

Through resort to this method Cutter has, therefore, obtained cure in a number of cases and arrest of the growth in a further series. The method has, however, a decided mortality rate, and we therefore do not favor it. Amongst the advocates of the method is W. H. Baker, of Boston. He has, however, modified it in certain particulars. He has obtained entire disappearance of the growth in one instance, and diminution from one-third to one-half in twelve cases. In common with many others, Baker does not approve of the form of battery used by Cutter. He states that, the resistance of the body or of the tumor to the galvanic current being great, all authorities agree that the size of the cells should be moderate, or small and numerous, in order that the intensity of the current may be increased, and thus the resistance overcome; whereas in the battery described (by Cutter) the surface of the plates is so great that the quantity of galvanism generated is large, which is valuable when thermic action is desired, but the intensity of the current is so low that the power of such a battery in conveying a galvanic current through a tumor would be small. He hence uses a Fleming and Talbot battery of thirty cells, and steel electrodes japanned to within one inch of the tip, this being gold-plated. His experience leads him to formulate the following rules: 1. It is best to select a time for resort to electrolysis other than during, or for a week before, the menstrual period. 2. An anæsthetic should always be administered. 3. Electrolytic needles should be used for both positive and negative poles. 4. The needles must be absolutely clean. 5. They should be buried deep in the tumor, so that the current may be entirely limited to the growth. 6. The needles should be inserted at the most prominent point of the tumor, either through the abdominal walls, the vagina, or the interior of the uterus, and the two needles should not be too nearly approximated. 7. The two electrodes being in the growth, one externally and the other internally, it matters not whether the positive

needle or the negative is internal. 8. The needles having been inserted, the circuit should be completed, and, beginning with four to six cells, we should within two or three minutes gradually increase the number to from eighteen to thirty cells of an ordinary battery, the number required varying much with the cleanliness of the battery and the freshness of the fluid. 9. The length of time occupied in the application should be from ten to twenty minutes, to be determined by the character of the pulse; and when this is found to be much more slow than normal, and weak, the current should be either entirely discontinued, or the number of cells in use diminished. 10. There should be no interruption of the current during the application, and this should be gradually diminished and the circuit opened before withdrawing the

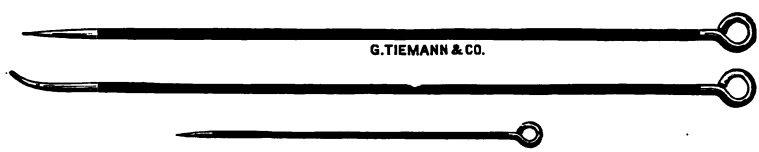


FIG. 53.—Freeman's Needles.

electrodes. 11. The application should never be made in one's office, for the patient should always at once be put to bed and remain there for one week.

The late Dr. Freeman, of Brooklyn, was also an advocate of puncture. His conclusions were thus expressed to us a few months before his death: All, or nearly all, non-malignant growths of the uterus may be cured by electrolysis without endangering life, if taken at an early stage. I have not attempted to cure in this way those immense fibroids measuring more than twelve inches in diameter. The kind and form of needle and the manner of introduction are of the greatest importance. That for the negative pole should be of steel, properly tempered, and strong enough not to break, insulated to within one-half or one inch from the point, the whole perfectly smooth and round, and brought to a fine point without

any cutting edge. This needle may be passed through any of the tissues without harm, as it separates but does not divide them. It is to be passed through the abdominal wall into the tumor from the most convenient point, always avoiding the intestines and bladder, or, in case of post-uterine fibroids, it may be passed through the vaginal wall into the tumor, making sure, in every case, that the uninsulated portion of the needle is entirely buried in the morbid growth. Hydrogen gas collects at this pole and keeps the needle always bright. The positive pole should never be attached to the needle that is passed through the peritoneum into the tumor. It should be attached either to a platinum probe of large size, insulated and inserted well into the cavity of the uterus, or to a slightly curved and insulated platinum needle which is passed through the os uteri and thrust into the base of the tumor. A spring clamp should be used to connect the needles with the conducting wires, so as to prevent frequent accidental opening and closing of the circuit. Sixteen to thirty ordinary zinc-carbon cells is as strong a current as I would advise, and from fifteen to forty minutes the limit of time. An anæsthetic should always be used, though the patient may be kept very lightly under its influence after the needles are introduced and connection is made with the battery, as the pain is not severe except at the opening and closing of the circuit. It is better to give plenty of time between the operations than to be in too great a hurry. Once, or at most twice, between the menstrual periods is often enough, and in some cases too often.

Apostoli's Method.—Apostoli's method differs radically from those just described. It has been adopted by the majority of electro-therapeutists in this country, as also notably by Keith, of Edinburgh. We proceed to describe it in sufficient detail to enable the reader intelligently to apply it.

The chief characteristic of the method is the high intensity used. Cauterization is aimed at, and this is posi-

tive or negative, according to whether the tumor is hæmorrhagic or not. The difference in the action of the positive and the negative poles must be strictly borne in mind, the one arresting hæmorrhage, and the other not but having a greater contractile effect on the tumor. Resort to the high intensities advocated by Apostoli is rendered possible by means of a large dispersing external electrode. Apostoli first used ordinary potter's clay for this external electrode, and this material, notwithstanding a number of modifications, best subserves the purpose. A large electrode of this nature enables the operator to resort to intensities as high as two hundred

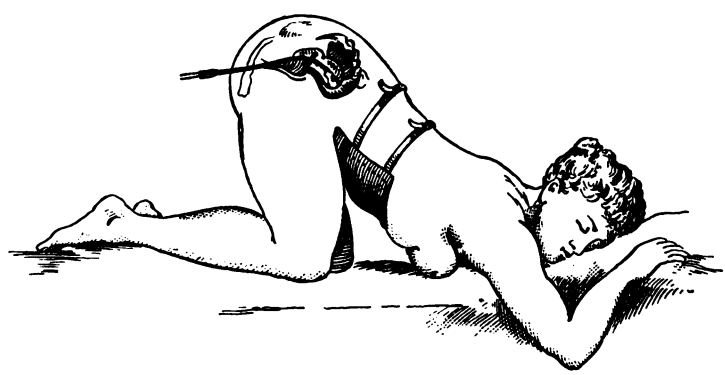


FIG. 54.—Clay Pad strapped to Abdomen, with Patient in Knee-chest Position.

and fifty and more milliampères without risk of cauterizing the abdomen, where the non-active electrode will ordinarily be applied. All the objections made to the clay as being nasty, cold, forbidding, and troublesome, are like the general cry about the uselessness and unreliability of electricity as a therapeutic agent. As a rule these complaints are made by persons who are entire strangers to electricity and its effects. In submitting to patients a choice of material to be used as an abdominal electrode, after testing the various things mentioned heretofore when high currents were used, *all* decided that "they preferred clay." The principal objections made to the clay

electrode may be easily overcome with care. The clay should be kept moist, instead of putting it away in a dish or tray, to be found, when needed for use, hard and dry, requiring to be placed in water to soak, a great deal of time being wasted before it becomes soft, and when it does it is simply a bag of mud. On the other hand, if it be not thoroughly saturated it is unfit for use. Here is the source of all the complaints, and from which prejudices are formed against the use of clay. The trouble is clearly

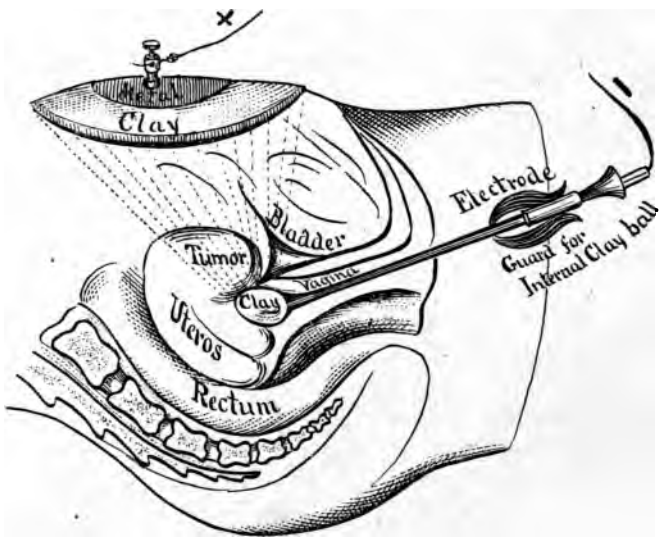


FIG. 55.—Tumor in Anterior Wall of the Uterus. Gunning's electrode in the vagina.

seen to be, *simply*, not knowing how to care for it or use it. It is not a difficult matter to manage the clay if its consistence is right at the start. When the electrode is removed from the abdomen, manipulate it to the consistence of good working putty, then dip it into water to moisten the surfaces, after which place it in a piece of flannel thoroughly wetted, roll it up snugly, place this roll of flannel and clay in a piece of table oil-cloth, oiled muslin, or rubber cloth, of sufficient size to completely

cover it; or a bag made of the material will be very convenient. Care must be taken that it is nearly air-tight. When needed for use remove the external covering from the flannel, and place the flannel with the enclosed clay in a basin of boiling water, letting it remain there for a few minutes until it becomes hot throughout. On removing the flannel the clay will be found warm and of good consistence to be readily modelled to the abdominal surface with but little soiling of hands or parts.

It may be stated generally that this clay electrode constitutes a real advance in the electrolytic treatment of fibroid tumors. It is not possible to obtain the full effects of the current through any other.

Where the uterine cavity is accessible to the internal electrode, Apostoli so inserts it; but if the canal cannot be reached or passed, he then punctures with a needle insulated to within one-quarter of an inch of the point, the vagina being the site selected for puncture. It is apparent that in resorting to such high intensities Apostoli aims not alone at the remote electrolytic effects of the current on the tumor, but also at its caustic effect on the endometrium in instances where the platinum electrode may be inserted into the cavity of the uterus. This cauterizing action is especially desirable in case of hæmorrhagic fibroids, where the hyperplastic mucous membrane is studded with very vascular fungosities or vegetations.

In regard to the intensity of current to be selected, Apostoli lays stress on the absolute necessity of its toleration by the patient. The current should never give pain. The well-worked plastic clay pad is placed on the abdomen, covering as large a surface as is possible. The platinum sound is inserted into the uterus, or, if the cervical canal be not accessible, the tumor is punctured *per vaginam*, the connections of the rheophores are carefully examined in order to avoid interruption of the current by the breaking of a connection, and the current is slowly turned on by means of the regulator until the patient can stand no more. Apostoli advocates séances

two or three times a week, of five minutes' duration. After each séance the patient should rest quietly on a couch for an hour or more, and exceptionally should remain in bed for the rest of the day.

After a close analysis of the literature of the subject, F. Engelmann, of Kreuznach, reaches the following conclusions in regard to the worth of Apostoli's method: The reputation of many of the gentlemen who have conscientiously tested the method carries with it the con-

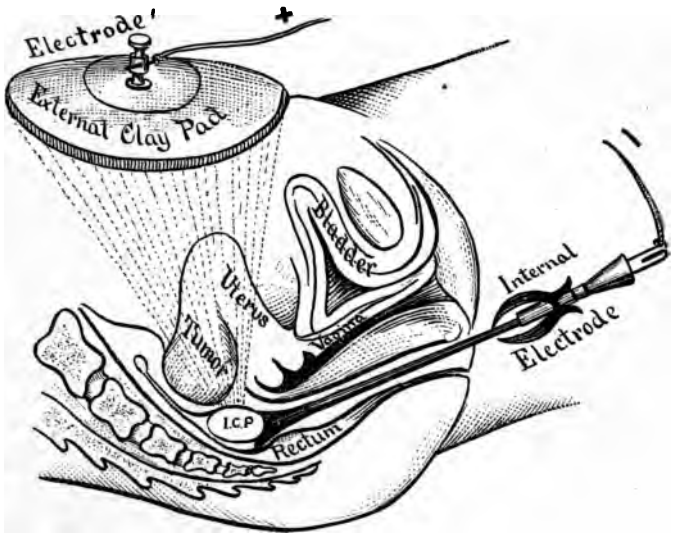


FIG. 56.—Tumor in Posterior Wall of the Uterus. Gunning's electrode in the rectum.

viction that there must be something. Many of them are men against whom the charge cannot be brought that they select the method because they are afraid of the knife. When we analyze the objections to the method, the conclusion is forced upon us that the opponents have either not tested the method sufficiently, or else that their failures are due not so much to the method as to the fact that the details were not efficiently followed out. In certain cases antisepsis was neglected; in others, where puncture was resorted to, this was beyond the depth

Name of operator.	Reference.	Size of Tumor.	Symptoms.	Duration of Treatment and Method.	Ultimate Result.
Apostoli.....	Carlet's book.	Two fingers' breadth above umbilicus, filling the pelvis. 15 cm. in depth.	Retention of urine. Cachexia. Pain. Vomiting.	11 negative, 25 positive intra-uterine.	Two fingers' breadth below umbilicus. 11½ cm. in depth. Menstruation normal. All symptoms disappeared.
Apostoli.....	Carlet's book.	Two fingers' breadth above umbilicus. Girth, 101 cm.	Loss of flesh. Pain. Amenorrhœa for 10 months.	4 electro-punctures, 10 negative applications.	Girth, 94 cm. Not much change in general symptoms.
Apostoli.....	Carlet's book.	Girth at ensiform cartilage, 110 cm.	Loss of flesh. Inability to walk. Vesical tenesmus.	3 punctures, 2 negative applications.	Marked decrease in size. Girth, 94 cm. All pressure symptoms have disappeared.
Apostoli.....	Carlet's book.	Between symphysis and umbilicus. Depth of canal, 14 cm.	Sharp pains at intervals.	7 negative applications.	Depth of canal, 10½ cm. Tumor smaller. Ceased treatment.
Apostoli.....	Carlet's book.	Three fingers' breadth below xiphoid cartilage. Girth, 124 cm. Depth of canal, 21 cm.	Great hæmorrhage. Dyspnœa.	12 negative and 11 positive applications.	Girth, 117 cm. Depth of canal, 12 cm. Menstruation normal. General health good.
Zweifel.....	Central. f. Gyn., 1884, 50.	Greatest girth, 103 cm ..	.....	About 25 milliampères, both electrodes external.	Greatest circumference, 93 cm. Tumor much softer than previously.
Skene Keith.	Ed. Med. Jour., Feb., 1888.	Entire abdominal cavity and pelvis filled.	Retention of urine. Hæmorrhages.	13 negative applications, 200 milliampères.	Movable. Not reaching ribs. Menses normal. Urinary symptoms gone.
Skene Keith.	Ed. Med. Jour., Feb., 1888.	Canal 4½ inches in depth. Pelvis filled by the tumor.	Amenorrhœa. Pain.	14 negative applications, 2 punctures.	Depth of canal, 3½ inches. Menses normal. Pains have disappeared. Tumor shrunken into pelvis.

Skene Keith.	Ed. Med. Jour., Feb., 1888.	Pelvis filled. Extends up to ribs.	Irritability of the bladder. Pain.	23 negative applications.	About one-half previous size.
Skene Keith	Ed. Med. Jour., Feb., 1888.	On the right to umbilicus; on the left higher; filling pelvis.	Of 20 years' duration. Inability to walk. Great pain in the entire abdomen.	23 negative applications, from 100 to 200 milliampères.	On the left to umbilicus; on the right 2 inches above symphysis. Symptoms all disappeared.
Skene Keith.	Ed. Med. Jour., Feb., 1888.	To umbilicus..	Hæmorrhages...	17 positive applications.	Two inches below navel. Hæmorrhages checked.
Skene Keith.	Ed. Med. Jour., Feb., 1888.	Depth of canal, 6½ inches. Extends 1 inch above navel.	Hæmorrhages...	7 positive and 13 negative applications.	On the right extends to navel; on the left no trace of tumor.
Playfair . ..	Lancet, July, 1888.	Depth, 3½ inches. Size of an orange above cervix	Hæmorrhages. Menses last 12 days.	14 positive applications of 200 milliampères.	Menses reduced to four days.
Playfair	Lancet, July, 1888.	Depth of canal, 4½ inches. Extends just above navel.	Hæmorrhages...	6 positive applications.	Menses normal.
Playfair ...	Lancet, July, 1888.	Depth of canal, 3½ inches. Large tumor in post. wall of uterus.	Great hæmorrhages.	6 positive applications, the first during hæmorrhages.	Hæmorrhages checked.
Playfair	Lancet, July, 1888.	Between umbilicus and symphysis. Depth of canal, 4 inches.	Constant hæmorrhage.	12 positive applications.	Menses normal.
Playfair	Lancet, July, 1888.	Fills the pelvis and extends 2 inches above the pelvic brim.	Tenesmus. Anuria.	5 punctures of 50 to 100 milliampères.	Tumor much smaller. All pressure symptoms gone.
Bröse.....	Cent. f. Gyn., 1888, S. 314.	Two cases without details	....	Cathode in cervix, 20 milliampères.	Much smaller. Symptoms disappeared.
Scott.....	Am. Jour. Ob., March, 1888.	Depth of canal, 3 inches. A number of tumors in post. wall of uterus.	Hæmorrhages...	No data given.....	Menses normal. Tumor no longer to be felt.
Werner.....	Am. Jour. Ob., April, 1888.	Fills pelvis Depth of canal, 4½ inches.	Pain. Hæmorrhages.	2 punctures	Uterus 2½ inches in depth. Feels well.

Name of operator.	Reference.	Size of Tumor.	Symptoms.	Duration of Treatment and Method.	Ultimate Result.
Werner.....	Am. Jour. Ob., April, 1888.	Uterus 3½ inches in depth. Fills one-half of pelvis.	Dysmenorrhœa (great).	36 intra-uterine.....	Depth of canal, 2½ inches.
Werner.....	Am. Jour. Ob., April, 1888.	Two fingers' breadth above navel. Depth of canal, 4½ inches.	Menses last 10 days.	Intra-uterine and puncture twice a week for 5 months.	Menses normal. Decrease in size to one-third.
Werner.....	Am. Jour. Ob., April, 1888.	Tumor under ribs. Circumference, 46 inches.	Hæmorrhages...	Puncture twice a week.	Depth of canal, 2½ inches. Menses normal. Circumference at navel, 34 inches.
Martin.....	Am. Jour. Ob., June, 1888.	Extends to navel, filling the entire pelvis.	Hæmorrhages...	74 intra-uterine applications during 11 months.	Depth of uterus, 5½ inches. Circumference, 35½ in. Menses normal.
Martin.....	Am. Jour. Ob., June, 1888.	Filling pelvis and abdominal cavity. Uterus measures 19 cm.	Hæmorrhages...	30 intra-uterine.....	Uterus measures 16 cm. Menses normal.
Martin.....	Am. Jour. Ob., June, 1888.	2 inches below the navel.	Pain. Hæmorrhages.	37 intra-uterine applications.	Decrease one-third. Pain and hæmorrhage not much bettered.
Martin.....	Am. Jour. Ob., June, 1888.	Uterus measures 6 inches. Tumor very large.	Pain.....	25 intra-uterine applications.	Decrease one-third. Uterus measures 5 inches. Patient comfortable.
G. Engelmann	....	2 inches above navel, filling the pelvis.	9 punctures. Needle inserted 8 cm., 60 to 80 milliampères.	Pelvis free from tumor. Lies between navel and symphysis.	Patient comfortable.

which Apostoli indorses. In order to reach a personal opinion, Engelmann selects for study only those cases (1) where it is absolutely proven that the instance was one of myoma and not a case of subinvolution, chronic metritis, etc.; (2) where sufficient data are given in regard to the tumor before and after the application of the method. That this latter point is most essential is proven by reference to Carlet's report of Apostoli's cases. Many of the cases there recorded are unquestionably simply instances of subinvolution or of chronic metritis.

Engelmann tabulates the cases on pages 114–116 for critical analysis.

It is apparent from this table, says Engelmann, that the influence of the treatment on the hæmorrhages is almost always favorable. Seeing that these hæmorrhages are the symptoms which imperil the life of the patient and bring her to the operating table, therefore the conclusion that Apostoli's method is of value. Further, the action of the constant current on the general symptoms is a marked one. The pains and the pressure symptoms are favorably affected. This depends, of course, on the decrease in size of the tumor. In regard to this point reports differ markedly. Whilst certain gentlemen record the entire disappearance of the tumor, Apostoli and others state that this is not to be expected. The tumor remains, although smaller, but the patients consider themselves as cured; and they practically are, since their symptoms have disappeared. Apostoli, as the result of his prolonged experience, states that this betterment is lasting. As a general rule the tumor seems to diminish to two-thirds its original size. Untoward results are still to be noted. Many cases have been recorded where uterine colic, elevation of temperature, inflammatory exudates, even abscess (after electro-puncture), have resulted. The latter complication is very likely to follow puncture of cysto-fibromata, and cases have been reported, under this heading, of death. Engelmann, therefore, is not inclined to favor the method by puncture; at any rate, it

should only be superficial—to the depth of one to two centimetres. Above all, in the application of this method, the strictest attention should be paid to antisepsis.

Quite recently Apostoli has written the following defence of his method, indicating the reasons why it acts beneficially, as well as the fundamental principles on which it rests :

By the method the pelvic circulation is equalized. Antisepsis is secured, varying with the intensity of the current utilized. Rapidity of effect varies in proportion to the electrical energy established. The intra-uterine method of application is far superior to the vaginal, for the following reasons : The maximum of current energy is thus utilized ; we thus obtain the antiseptic action of the positive pole—an action which extends throughout the interpolar circuit, even to the negative pole ; we obtain as well a derivative and a caustic action, and thus we treat effectually the endometritis which complicates the fibroid, the result being a more complete and permanent cure ; the method is less painful than the vaginal, and we can thence the better resort to high intensities, which means greater efficacy of method ; by means of vaginal galvano-puncture to the depth of two to five milmetres (the needle being of gold and insulated to the point), we may still better localize the galvanic action and render small and medium doses more efficacious ; the method is not dangerous—thus from July, 1882, to July, 1890, Apostoli had made 11,499 galvanic applications, of which number 8,177 were positive intra uterine, 2,486 were negative intra-uterine, 222 were positive vaginal galvano-punctures, 614 were negative vaginal galvano-punctures. Of the 912 patients treated, 531 had fibromata. There were two deaths—one puncture of a subperitoneal fibroid, and one as the result of puncture of an ovarian cyst mistaken for a fibroma.

In August, 1889, Dr. Thomas Keith, in conjunction with Dr. Skene Keith, published the results in one hundred and six cases treated after Apostoli's method. The ave-

rage number of applications made was twenty-eight. Three cases died during the treatment or shortly after, but this result could in neither case be attributed to the method. In the remainder of the cases the improvement was almost uniform. Diminution in size of the growth, arrest of hæmorrhage—such were the results.

Occasionally, it should be stated, Apostoli's method fails to arrest hæmorrhage. Almost invariably the reason will be found to be that some detail of the method has been neglected. Lapthorn Smith states the following as the essentials on which success of the method depends: It must be scientifically applied; and unless a reliable and accurate instrument is employed to measure the current, it cannot be said that it is applied scientifically. The strength of current necessary to cauterize varies in direct proportion to the amount of surface over which it is spread out. Martin, of Chicago, has ascertained by experiment that a current of twenty-five milliampères traversing a positive platinum electrode of one square centimetre of surface, pressed firmly against the mucous membrane of an hypertrophied cervix, the circuit being completed by a large abdominal electrode, will produce a dry, condensed condition of the tissue beneath the surface of the plate on the membrane in five minutes.

What are we to do in cases where for various reasons the patient can only bear fifty to seventy-five milliampères? We must simply take the precaution to expose not more than two or three centimetres in length of such a sound. If the uterine cavity is longer than that, then it must be treated in successive sections on the same or on different days. By using carbon electrodes of definite surface, we can regulate the strength of current necessary for cauterization: or by using flexible bougies covered with platinum, gold, or aluminium wire over a certain extent, of which more will be said later, the same object may be still better attained. As the higher the current which may be borne the larger the extent of

intra-uterine mucous membrane which can be dried up at a single sitting, it is very important to leave nothing undone that will render strong currents more bearable; this requires attention to three details:

1. To have the cutaneous electrode as large and moist as possible.

2. As the pain at the intra-uterine electrode must be concentrated to a definite strength—namely, twenty five milliampères per square centimetre of surface—in order to be effective, it is obvious that we cannot diminish the intensity and consequent pain without at the same time lessening the efficiency. In other words, pain at the cutaneous electrode is avoidable no matter how large the dose, while it will be present at the active or internal electrode whenever the intensity passes a certain point. This point varies, however, very much in different women, in direct proportion to the degree of development of the nervous system. Some women will endure without complaining one hundred and fifty milliampères, while others, more highly nervous, will hardly endure twenty-five. In these latter women the best thing to do is to give them a small sprinkler bottle of the A. C. E. mixture in one hand, and tell them to smell it from their handkerchief doubled up in the other hand. You begin at zero and increase the dose gradually until she has become slightly under the influence of the anæsthetic but not unconscious, when she will easily bear the desired strength of current. As long as she is able to feel very much she is able to help herself to the mixture, but when her sensibility has been sufficiently dulled she will cease to put any more on her handkerchief. As soon as the maximum has been reached the anæsthetic may be removed. In employing this treatment on highly educated and nervous women, I feel satisfied that a little anæsthesia enables us to employ much more effective doses without any pain whatever.

3. Fortunately women become accustomed to the passage of the current. Besides, their sense of modesty and

their sense of fear must be overcome, especially as the latter is often mistaken for pain, so that it is very important to begin this treatment with great gentleness, not exposing the patient needlessly, and proceeding very slowly until she becomes accustomed to it.

4. The treatment must be carried out systematically, that is, at regular intervals, until the bleeding has been stopped. Some patients will come once and then not return for a couple of weeks. One of the usual excuses is that they did not like to come while they were unwell; but as some of them are unwell for twenty-five days out of thirty, it is necessary to explain to them that the treatment must not be delayed for that. I generally allow them to lose for two or three days, but if the flow is very severe I stop it at once. In fact, in a case of bleeding fibroid I go on with the treatment three times a week, quite irrespective of menstruation, until toward the end of the treatment, when I allow the patient to have a period without interference, in order to test my work. If we could give enough current at the first application to completely destroy the whole of the endometrium, and if that spongy, diseased lining membrane did not return again, then one application would invariably cure the patient. But such, unfortunately, is not the case. It requires several preliminary applications in order to test the patient's endurance or tolerance. Then it takes two or three more to reach a point where it becomes effective. Then we may not be able to turn on enough current to cauterize more than a quarter of the entire surface if we do it in sections, or to cauterize through more than a quarter of the thickness of the vascular membrane if we try to do all the surface at once.

One of the commonest causes of failure, I believe, will be found in the neglect to apply this coagulating surface of the positive pole to the whole of the bleeding surface, and, to tell the truth, with Apostoli's solid platinum sound this is in some cases not only difficult but sometimes impossible.

The uterine canal in some cases is so deformed in direction by the projection of the tumors into it that a sound must describe many curves before it can reach the fundus. Over and over again I have failed to introduce a uterine sound, or even a small probe, further than two and a half inches, and yet the canal was found to extend to over five inches by passing a flexible bougie; so that such cases, when treated by Apostoli's method with the solid platinum sound, are bound to be failures, simply because the bleeding surface of the cavity of the uterus is never reached at all.

Apostoli's method, when attention is paid to minute details and the case is well selected—that is to say, the fibroid is not associated with any disease of the appendages—cannot be called dangerous, and in this respect it has the advantage over double puncture through the abdominal wall. It is not claimed for the method that it will cause the disappearance of the tumors, but only that by means of it growth may ordinarily be arrested, diminution in size may often be acquired, and the symptoms may be palliated. In view of the fact that a fibroid rarely kills, in view of the further fact that if the patient can reach the menopause the tumor will involute with the uterus, obviously this method of electrolysis, or the next to be described, should be tested before subjecting the patient to that most dangerous of all abdominal operations, hysterectomy, as also before resorting to removal of the appendages for the purpose of inducing early menopause and thus indirectly affecting the tumor. The method has, it must be stated, a mortality rate, but this is exceedingly low and not at all comparable to that from hysterectomy. In the majority of cases where death has ensued after resort to the method, this has been due to its faulty application. Error in diagnosis cannot condemn electrolysis for fibroids. The contra-indications to the method are few, and these we have already dwelt upon.

Gunning's Method.—After a careful study of the punc-

ture plan of treatment by the platinum spear electrode, with special reference to the effect upon the tissues by the electricity at the seat of puncture, it seems to belong more properly to a cauterizing than to an electrical method, though there is marked electrolytic action upon the tissue during the application. The results produced upon the tissues, however, in the immediate vicinity of the platinum spear, are like those from a cautery, and are followed by all the changes produced by a burn, such as inflammation and suppuration, thereby causing the patient the risk of sepsis.

One may ask the question, Is inflammation conducive to absorption where a hyper-supply of blood is already feeding the tissue, when the plan and theory of the treatment is to lessen it and thereby cut down the amount of nutrition supplied to the part? It may be considered orthodox in some minds so to do, but it does seem to savor somewhat of heterodoxy to put oil on a fire to extinguish it. Electricity is the energy that possesses the power of exciting the tumors to contraction and degeneration when using a puncturing electrode. The plan of treatment now to be considered is the non-puncturing, and is the same laid down by Apostoli, with that exception, making it purely an electro-galvanic one to lessen the danger from inflammation, suppuration, and sepsis, and the results have been equally as satisfactory as in the cases treated by puncture.

The rules given by Apostoli must be observed rigidly as to the necessary use of aseptic washes before and after applications of the current of electricity, particularly when the naked electrode is used; and in this place it is suggested that the platinum point be used *only* when the tumor is of the *hæmorrhagic* form and requiring the electrode to be introduced into the uterine canal. This aseptic precaution does not bear particularly on the electrode itself at the point of application, because the current will kill all germs that may be upon it (as it must be the positive pole, or the chemical one, that is

used for hæmorrhage), but it is essential to prevent the absorption of the germs that may be transported to the immediate vicinity of the surface cauterized by the electrode which is not acted on by the electricity. The next item of importance to be carried out in the treatment is the preparation of the abdominal surface of the skin. This is done by carefully bathing the abdomen with diluted vinegar or acidulated water (sulphuric acid one drachm to water one pint), making the skin clean, removing salts and oily products of excretion, and softening the horny layer, in this way lessening the resistance of the skin to the electric current. When the abdomen is thus prepared, the next step is the placing of the abdominal electrode. Let this always be the first in the order of application, for this reason: that when every other appliance of the apparatus is in position and the connections all made ready for the turning on of the electricity, the skin under the abdominal electrode has become moistened, thereby facilitating the transmission of the current and thus saving time. The *only* substance to be used for an abdominal electrode is *clay*, notwithstanding the numerous substitutes that have been suggested. Apostoli says clay is the material, and experience indorses this. There is no substance that can be so completely adapted to the irregularities of an abdominal surface over a tumor, and which makes such close contact with the skin.

There are two very strong reasons why towels, cotton batting, metal discs covered with skin, and other appliances that have been mentioned as substitutes for clay, should not be used. First, in the line of economy—so much power of the battery is lost in consequence of the great resistance placed in the circuit. Second, these substances cannot be brought sufficiently close to the skin; and as a result great pain is produced by the many points of creases and other irregularities acting as so many small conductors, leading the electricity to the skin and producing a disagreeable pricking, stabbing,

burning pain that causes a dread and anxiety to the patient—two important conditions to be overcome for successfully carrying on the treatment.

The description of Gunning's instrument for internal use will introduce the reader to the special difference of this plan of treatment from that by puncture. For reasons already given, this electrode is to take the place of the platinum spear, or any other instrument used for puncture, and the class of cases to be thus treated are the non-hæmorrhagic forms *only*, for which purpose the negative pole is used. This electrode has been described in the chapter on instruments, but a more elaborate reference is deemed necessary. This instrument, having a carbon ball for the applying surface, is covered with a thin layer of clay, over which a thin piece of mosquito netting is drawn and carefully tied around the neck of the carbon ball; when thus fastened the bell-shaped rubber ring at the end near the ball is passed over it, protecting the delicate parts of the canal into which it is to pass. Then the speculum-shaped guard is slipped over the clay-covered ball, ready to be introduced into the canal. When thus placed, this speculum guard is easily removed by pressing upon the protruding ears, when the points that are in the cavity open, and the ball can be pushed through without irritation into the canal. Then the guard can be withdrawn and slid part of the way along the electrode towards the handle, or it can be removed entirely from the electrode. Then push the end of the electrode into the cavity to the site of application.

It frequently happens that the seat of fibroma is at such a distance from the uterine canal that a line drawn from the point of an electrode in the uterine canal to the abdominal electrode would leave the tumor entirely out of the direct rays of the contracting power of the electricity, and the only influence it would receive would be simply the inductive one.

Again draw a line similar to the one just mentioned,

[illegible] the tumor would be included if the [illegible] were followed. Then suppose a puncture [illegible] made with a platinum steel into the tumor [illegible] Fig. 5, what part of the tumor would be reached? [illegible] the puncture were made through the vaginal walls into the tumor what assurance could one have that the [illegible] Instead of the puncture [illegible] the [illegible] as shown in Fig. 5, and turn on the current to any number of milliampères. Usually a current of one hundred to one hundred and fifty is used, and that the electricity can do is obtained in this procedure without a burn or even a denuded surface, saving the entirely [illegible] apprehension of danger. The internal electrode rests directly under the tumor (the vagina having been moulded to a certain extent so as to cover the surface of the tumor in the roof of the vagina). The external electrode is in position on the abdomen. The rays coming from it to the electrode under the tumor increasing the ray lines of the electricity coming from the larger surface down to the smaller, like the rays of light through a burning-glass. The reason the course of the rays of electricity are as illustrated is shown by an experiment derived from a static machine. If a frictional machine is running in the dark, and a large disc of metal be suspended in the circuit and a metal-pointed electrode be brought toward it, when at a proper distance the rays will be seen coming from the disc and focussing at the point of the metal electrode. In the treatment of the tumor the theory is that, if the rays can pass through such a medium as the air in that way, surely when it has assistance, as undoubtedly it has from the moist tissue that may be in the line of the current between the electrodes, the effect produced is one of squeezing or contraction, gradually increasing from the larger to the smaller points. This is a sensation complained of by the patient while being treated: "This feels as if I had been taking ergot." A sound rule is, *always apply the internal electrode* to the largest presenting part. It may so happen

that the part selected is in the rectum. This is rather an awkward place to make an application, but it can be done very easily by using the electrode heretofore mentioned, employing the metallic guard over the clay in the way suggested for the vagina. When the electrode is in the rectum, pass it up until it reaches the position desired. Having made an examination before introducing the instrument, and mapped out the topo-

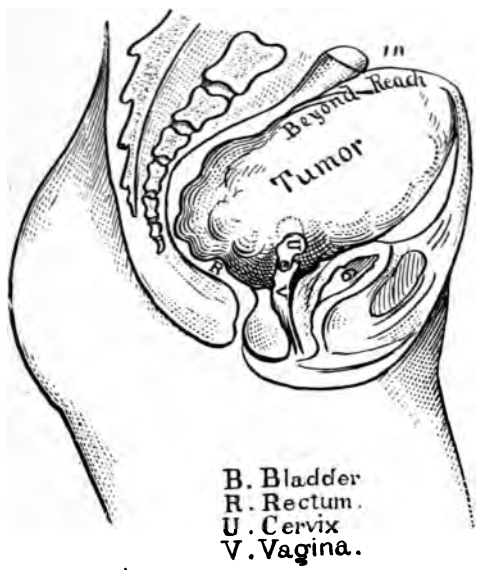


FIG. 57.—Tumor before Electrolysis.

graphy of the tumor, one knows just where the instrument should be applied. Always bear in mind that the tumor should be directly in the line of the current. The rectum is rather more irritable than the vagina, but after a few treatments it becomes quite tolerant to the electricify, and very little objection is made by the patient to this cavity for application. To illustrate this *non-puncturing* plan still further the accompanying figure from an actual case is inserted.

Examination *per rectum* revealed the tuberosities shown in Fig. 57, extending up as far as the upper third of sacrum, under the tumor, and nearly filling the cavity up to the sacrum. The space was so small between tumor and bone that it was with the greatest difficulty a small catheter could be passed. This accounted for the small form of fæces. This case was treated without puncture, and after forty-four treatments of five minutes' duration two or three times weekly, with an average strength of current of one hundred and four milliampères, the tumor presented the condition shown in Fig. 58. The rectum became normal in size. The tumor moved in its contractions in the following manner: upward, backward, laterally. The uterus became generally mobile. The patient was permitted to marry, and is at the present time well in color, disposition, and weight—in fact, a picture of health.

Danion's Method.—Lêon Danion, of Paris, follows a different method from that suggested by Apostoli. He claims that he has irrefutably proved the following charges against the latter's method: 1. The method of treatment of fibroids by the chemical galvano-cautery is a gross scientific error. 2. Intra-uterine action and puncture, the essentials of the method, are unnecessary and useless. 3. Arrest of hæmorrhage does not depend on a caustic action. 4. There exists no difference between the poles. 5. The method is often painful, and carries with it risks which in a certain proportion of cases must necessarily prove fatal. 6. These risks depend on the high galvano-caustic intensities utilized. 7. More rapid and better results are obtainable through the method which he himself proposes, and this, too, without danger. This method consists in intra-cervical and vaginal applications by means of his *tampon électrique*, combined with changes in the current (by means of the pole changer) while the current is in action. Danion lays stress on the fact that through his method all intra-uterine action, as well as caustic effect and puncture, is avoided. He has utilized

this method on fifteen hundred occasions without the least untoward result, and he claims that his results are superior to Apostoli's.

This method has not as yet received the consideration which it deserves. Emanating from a careful observer and a distinguished electrician, the claims advanced should be put to the test; for it would be a great gain indeed were it found possible to affect fibroids without the necessity of cauterizing the endometrium or of resorting to puncture.

OVARIAN CYSTS.

The results obtainable nowadays from ovariotomy, especially since it has become the surgical rule to operate as soon as the cyst is discovered—that is to say, even though it be small, since thus we avoid the accidents associated with its growth—render scarcely justifiable resort to electrolysis. Since, however, such a method has been practised, it is but fair, in a treatise of this nature, to refer to it, even though it be in condemnation.

The method has been described and practically tested by Fieber, Von Ehrenstein, Ultzmann, and Semeleder. Mundé has elaborately analyzed the recorded cases. Semeleder has proved himself one of the most enthusiastic of the advocates of the method, and, were it not that there is a safer method of treatment for these cysts, the cases which he has recorded would justify its general acceptance. In his papers to which we have had access he has reported twenty-seven cases, seventeen of which were completely cured. Similar results, however, have never been obtained by other operators; at least they have not been published, for Von Ehrenstein has never substantiated his claim that of several hundred ovarian cysts subjected to electrolysis nearly fifty were cured. In Mundé's monograph fifty-one cases are collected and analyzed, with the following results: Cures, twenty-five; permanent improvement, three; temporary improvement, four; negative results, six; peritonitis with recovery, four; deaths, nine. While no one will question the possibility of curing

ovarian cysts by subjecting them to electrolysis, the question to-day is as to whether the method has advantages over ovariotomy when considered in the light of possible dangers and of mortality. When Mundé's analysis was made he was able to draw the following comparison between the two methods: "Notwithstanding these undoubted cures, the percentage of success of oöphoro-electrolysis (fifty-five per cent) compares unfavorably with that of ovariotomy (seventy to eighty per cent); Spencer Wells seventy-eight per cent—in 1876 as high as ninety-one per cent; and so also do the deaths by electrolysis (seventeen and six-tenths per cent) nearly equal those following ovariotomy in recent years (twenty to thirty per cent, to twenty-two per cent), and far exceed those occurring in the last series of fifty-five cases of Spencer Wells." In the years which have elapsed since these comparative statistics were given, the mortality rate from ovariotomy, when performed with the requisite precautions, has sunk so low that it has become an operation which *per se* carries with it scarcely any risk at all, except in the highly unfavorable cases in which *a priori* no better result could be predicated from electrolysis. While resort to the method, therefore, cannot by any means be considered unjustifiable, it is none the less true that but few operators of to-day would sanction it in preference to ovariotomy.

The technique of electrolysis as applied to ovarian cysts does not differ from that usual in other instances where it is resorted to. Semeleder favors steel needles, and punctures with the positive pole, applying the negative at some distant part of the cyst. In instances which he treated, the number of séances requisite varied from six to one hundred and three. It is a method, therefore, which requires patience, and in its results is not at all comparable to ovariotomy.

ELECTROLYSIS FOR CANCER.

The electrolytic treatment of cancer of the uterus has

never received the attention which it deserves, when we remember the results obtainable from its application to morbid growths on the surface of the body. It would seem to be a method of treatment peculiarly applicable to inoperable cases of cancer, and yet but few instances are on record where it has been tested. By those who from their experience are competent to speak, thorough electrolysis is stated to be a most efficient safeguard against recurrence of the disease. Why, is not easy to explain. Possibly the action of the current is to stimulate healthy cell nutrition in the neighboring tissues; perhaps it is that the wound left by electrolysis has to heal by granulation, and that the tendency to abnormal

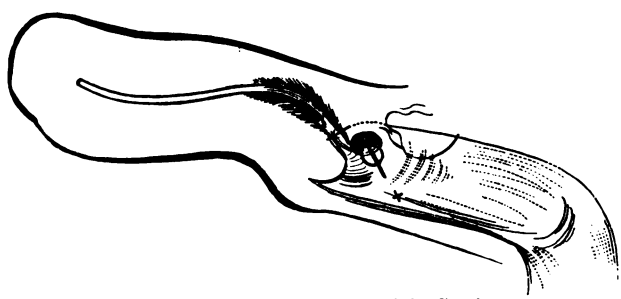


FIG. 59.—Electrolysis of Cancer of the Cervix.

cell proliferation may be checked during this process by negative cauterization. Whatever the explanation, the method recommends itself as a substitute, in inoperable cases of cancer, for such caustics as chloride of zinc or the arsenious paste.

The aim of the method is to so cut off the blood supply from the diseased surface as to cause it to slough. To accomplish this a number of needles connected with the negative pole are inserted as far as possible under the growth, and one or more platinum needles attached to the positive pole are thrust into the growth. A current of one hundred and fifty milliampères should be passed until it is apparent that a deep eschar has been formed. The negative needles readily drop out, but the positive

are firmly fixed in the mass, and they should therefore be left to come away with the slough, in order to avoid hæmorrhage.

Gunning prefers to introduce the needles separately, for the reason that they can the better be watched and controlled; further, the extent of surface acted on by each individual needle can be seen and the place for the insertion of the next may be the better determined

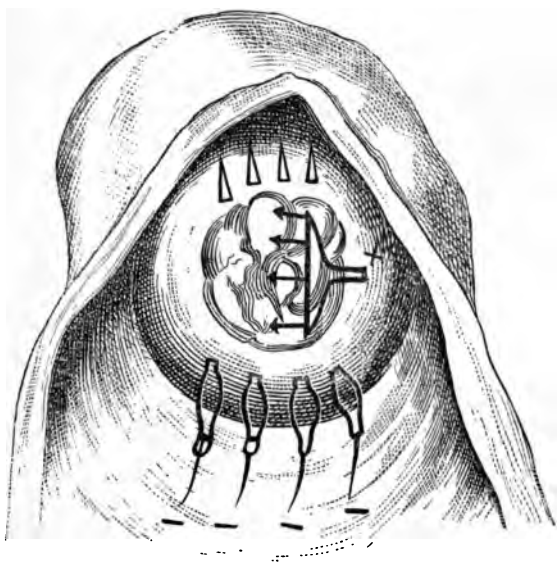


FIG. 60.—Needles in Position

He has devised special needles. These needles have a spring at the rheophore attachment, by means of which the needles are kept in close contact with the tissue. The needles, therefore, cannot progress until the parts have been thoroughly affected by the current.

These are the negative needles, to be inserted deeply into the healthy tissue at the base of the cancer. The positive needle—shaped like a tripod—is plunged directly

into the tumor. It is unscrewed from the handle and comes away with the slough. Care must be taken that this tripod does not penetrate entirely through the mass, else the current will be short-circuited. The hæmorrhage which occurs on the insertion of the tripod is at once controlled by the action of the pole, which is the positive. From fifty to seventy-five milliampères are amply sufficient to accomplish the requisite work. The séance will vary from five to fifteen minutes, according to the size of the growth, or until the growth has altered to a dark mass. The slough will separate in from six to ten days, and when it has been shed we find the base covered with healthy granulations, except in the intervals between the base needles. These are snipped by a pair of insulated scissors attached to the negative electrode. The points cut by the scissors are to be treated—as also the entire surface—repeatedly by the positive pole in case of hæmorrhage; otherwise by the negative. The object of the latter pole is to favor healthy nutrition. The intensity should only be of two or three milliampères. A simple dressing is then inserted into the vagina.

The only case as yet at our disposal is the following from Gunning's practice:

Mrs. X., æt. 50, first consulted the doctor in February, 1890. She stated that she had previously seen Doctors Emmet and Thomas. The former advised her to make herself comfortable, as her lease of life was at best but a short one; the latter suggested an immediate operation, else she would die in six months. She had no pain, but cachexia was present, and she complained of occasional hæmorrhage. Gunning was a trifle more guarded in his prognosis, being familiar with the effects of electrolysis on cancer on the surface of the body. He electrolyzed the growth thoroughly once by the plan just described. The slough separated in twelve days, the disease having been limited to the cervix. At the present writing—one year afterwards—there is absolutely no trace of there ever having been a growth. The cicatrix is soft and covered

with mucous membrane. The patient's symptoms have disappeared, and the prognosis for the future is quite favorable, provided the disease does not appear in the body of the uterus. The organ is now perfectly movable, whereas previously it was firmly fixed.

CHAPTER IV.

STATIC, FRANKLINIC, OR FRICTIONAL ELECTRICITY.

THE terms used in electricity, as static, galvanic, faradic, etc., are not given as indicating different kinds, but as suggesting the means employed to produce the agent. Static or frictional electricity means, in contradistinction to the others (electricity in motion), electricity at rest, and frictional denotes the method of generating it. This form of electricity is the oldest known. Among the ancients it was supposed to be the life of amber. When the amber was rubbed it became angry, so they thought, and manifested this angry state by attraction and repulsion. Very little was known more than this until about the year 1600, when a certain Dr. Gilbert published a monograph reviewing the above subject as then known, mentioning a list of substances possessing the same properties as amber, and giving to the science the name *electricity*, from a Greek word for amber. From the simple rubbing of the substances by hand, machines gradually were made. Among the first was a very simple device invented by Otto Guericke. It consisted of a globe of sulphur fastened to an axle to be turned by a crank, the hand being the only rubber. After a while glass was used instead of sulphur. Boze, of Wittemberg, was the next inventor. His machine consisted of a glass plate, a band wheel, and a collector. Improvement succeeded improvement until the large machine made for scientific purposes in London was constructed. It was the largest one on record, having a disc ten feet in diameter, and three pairs of rubbers, each three feet in length, and having a conductor six feet

long and four feet in diameter. It was run by steam power and gave sparks fifteen to eighteen inches in length.

In the year 1865 two Germans named Holtz and Töpler invented two new machines very much alike in con-

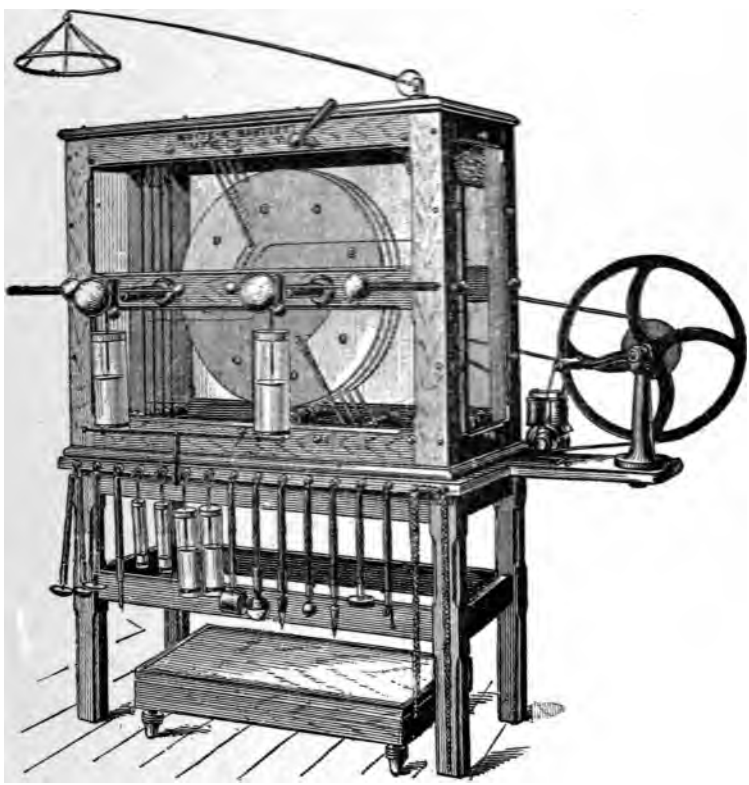


FIG. 61.—Static Machine.

struction, but differing in the power of generating. The one could excite itself, the other had to be supplied with a spark.

The Holtz machine consists of the following parts: Glass discs or plates, about one-eighth of an inch thick,

and varying in diameter from twelve to thirty inches, having their surfaces thoroughly covered with a good shellac varnish, are arranged in pairs so that one or more pairs can be used (the large machine made by the Waite & Bartlett Manufacturing Company has four pairs.) Each alternate one of the series is stationary, having the other or others attached to a spindle or axle by which they are made to revolve, allowing a space of one-quarter of an inch between the stationary and revolving ones. In these plates are cut holes, or windows as they are called. To these windows are glued pieces of aërated paper, having the irregularities projecting a little over the edge of the glass into the opening of the window. These are called inductors. Directly opposite these windows are placed brass forks or combs to catch the current when induced. These are fastened to brass rods resting on insulated posts that project outside of the machine when put together, having at their ends large brass balls to which are attached the Leyden jars or receivers. A piece of catskin is arranged as a movable fixture to be applied when necessary to incite the surface, or, as in some machines, it is glued on the bottom of the plates. On the axle or spindle is a small pulley which subserves the purpose of attaching power to revolve the plates. These parts of the machine should be covered by a case for the purpose of keeping them from dust, etc., and at the same time to have a chamber where the air can be kept dry—a very important matter with this, the Holtz machine. In fact, it is necessary to keep some anhydrous material always there; that commonly used is anhydrous chloride of calcium. If the machine is kept where the sun can shine on it, it will always work better. Projecting through the sides of this case are the rods previously mentioned, to which the combs are attached, for the support of the Leyden jars or receivers. These are outside of the case as a rule. On these rods are placed other brass bars arranged at right angles, so constructed that they can be moved backward and forward. They are

called the sliding rods. These rods have glass or hard-rubber handles for the purpose of moving them, to prevent a shock from the current reaching the operator, and are the electrodes of the battery. When the points of each touch, the current flows without any phenomenon; but when they are separated minute sparks can be seen between them. It is from the relation of these rods that the various influences used in therapeutics are obtained, from the interrupted, mild, contracting and stimulating influence like the faradic, to other effects, like that from

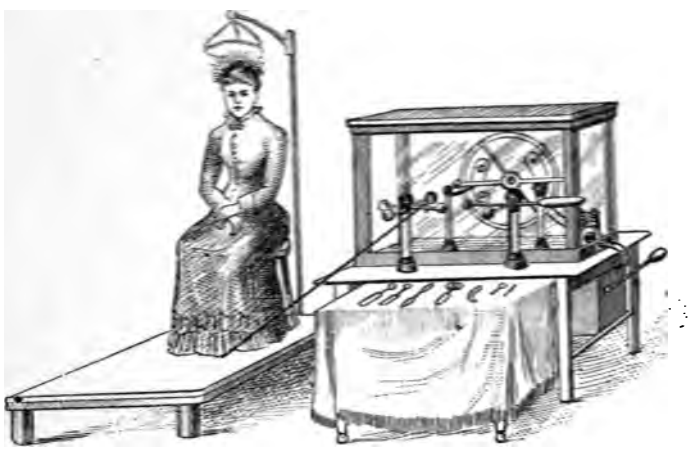


FIG. 62.—Static Bath.

sparks, or the still smaller influence known as the electric wind, where the manifestation is that of a gentle breeze blowing over one with a gentle, tingling sensation to the skin. At the end of the table on which the case rests is a wheel to which a crank is attached for the purpose of power. This should be securely fastened to the table, and should bear a relative size to the pulley attached to the revolving disc, so as to allow six or eight revolutions of the disc at each revolution of the power wheel. Motors of various kinds can be used for power; a water motor is the best when it can be obtained. Motors run by electricity as a rule are an expensive power,

nevertheless it adds to the impressiveness of the machine. In the treatment of uterine and pelvic lesions a motor is nearly an absolute necessity for convenience.

The Töpler machine is constructed in a general way like the Holtz, having the following points of difference: The plates are without windows; the inductors are larger, and have between them and the glass plate pieces of tin foil that are connected with each other, and upon the shellacked surface of the outside plate are glued pieces of tin foil having in the centre raised buttons of brass called carriers. Near these metal points are arranged little metallic brushes that are in close contact with the surface of the revolving plate. As this plate moves, the brushes touch the metal buttons and incite the current as the fur did in the Holtz. This machine, as a rule, except in damp or very hot weather, if kept in a dry place, will be ready for service whenever needed. A very neat, powerful, small, and good machine, having a clever device for obtaining an induced current, is known as Professor Atkinson's Töpler machine. It is of medium cost.

How the Static Current is Induced when the Plates are Set in Motion.—The friction from the hair to the plate, or brushes to the metal points, provokes the peculiar action of the molecules of the air and the particles of the shellac in the same way as that caused by the rubbing of the amber in the days of long ago, producing what is known as attraction and repulsion, two antagonistic conditions or states of electricity, which are so peculiarly related that a body cannot be electrified in one way without producing the same effect in an opposite one to the same extent, as will be noticed when glass and fur are rubbed together: both become excited, and the electricity produced in the glass is of an opposite kind to that produced on the fur. The form found on the glass is called positive, and that excited by the fur negative electricity. As has been seen, we have the two conditions, the positive and the negative, induced by the machine. The forks or combs mentioned when describing the

machine act as conductors and collectors, and by their peculiar construction and position gather the positive from one side of the glass plates, and the combs on the opposite side conduct the negative.

The Leyden jar—so-called after the city where it was devised—is utilized for storing the electricity. The jar is coated externally and internally with zinc foil up to one-fourth of its height. The interior of the jar receives the positive electricity from the conductor, and the exterior is charged with negative. A series of such jars forms a battery which may be charged with a large amount of electricity. When the exterior and the interior surfaces of the jar are connected by a brass rod, the electricity discharges with a report and the discharge is accompanied by a spark.

The Difference between Static and Galvanic Electricity.—"It will not be the purpose to do more than give a striking analogy of their points of difference, and to present certain facts from which one can readily draw deductions. In the first place, very differently constructed instruments must be employed in detecting the current. For the purpose of investigating the static current of electricity, we need to use an instrument called an *electroscope*, or, better, an *electrometer*. To detect the galvanic current a galvanoscope is used. A very interesting experiment can be shown with the electrometer in regard to the electrical influence even of the galvanic current. To perform this experiment it is necessary to attach to a glass rod a piece of zinc, and to another glass rod a piece of copper, then bring the metals into contact for a few moments, after which touch the brass knob of electrometer and the needle is deflected at once, showing that mere contact of zinc and copper electrifies the zinc positively, and, of course, the copper must be negative. This is a very feeble energy compared with what frictional electricity will give when glass is rubbed with silk. The difference of the electrical power (called potential) of the rubbed glass and silk is tens of thousands

of times greater than that of zinc and copper" (Forbes). The difference of power that gave in the experiment the deflection of the needle of electrometer two inches is almost what we take as a unit of power, called a volt.

The difference that exists between "static" electricity

FIG. 63.—Brass Ball Electrode.

and "galvanic" or "current" electricity is not an easy matter to define. "The difference is one of degree, not of kind, for the fluid is in both cases identical." Professor Tyndall's explanation of this point is very clear, and we cannot do better than quote his words: "A cubic

FIG. 64.—Wood Point Electrode.

inch of air, if compressed with sufficient power, may be able to rupture a very rigid tank; while a cubic yard of air, if not compressed, may exert but a feeble pressure upon the surfaces which bound it. Frictional electricity is in a condition analogous to the compressed air. Its

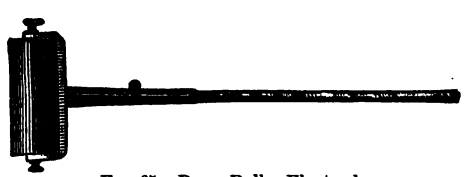


FIG. 65.—Brass Roller Electrode.

density, or, as it is sometimes called, its intensity or tension, is great. The electricity from the galvanic cell, on the other hand, resembles the uncompressed air. It exceeds enormously in quantity that from static machines, but it falls enormously below it in tension (Hepworth).

The difference between a discharge (or jumping current of static electricity) and a current of electricity is that a simple discharge, although it produces a number of other effects, has no action upon a magnetized needle, while an electric current is capable of changing its position."

Static electricity, though one of the best forms of electricity to be used in therapeutics, has been, until within the last year or two, entirely in the hands of the neurologist, and seldom used by the electro-therapeutist in the treatment of diseases of women. Possibly a reason may be that its action has been thought to be only of a superficial kind, and, not having power of penetration, consequently as being of no value except for peripheral stimulation; this coupled with the cost of a good machine. Another reason may be because there has been a lack of

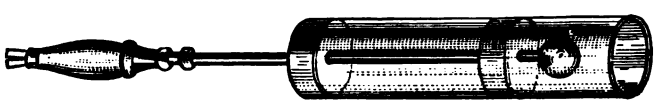


FIG. 66.—Gunning's Static Vaginal Electrode.

proper instruments for internal use. Dr. W. J. Morton, of this city, who has done so much to place static electricity in the therapeutic line, in the way of devising proper appliances, has recently added still more to his list in developing a compact arrangement by which the static induced current may be used in a manner like the faradic current, and with this instrument he uses electrodes for the vagina and uterus, thereby opening the way for bringing static electricity into more general use. These instruments are illustrated in Figs. 69 and 70. One, however, can be constructed with but little outlay, in the following manner, that will do fair work so far as application is concerned: Take a piece of glass tubing about an inch in diameter and six inches long; after carefully smoothing the rim or edge of the glass, introduce two pieces of cork, or, better, two rubber corks, each having,

former, a hole made in the centre of them the ... the electrode to be used—an ordinary bulb vaginal ... will do. Push one of the corks into the end of glass

... Static Induced Current to the Surface

... about two inches; the ... external end sufficiently ... Unscrew the handle ... has a handle—and pass

the stem of the electrode through the holes made in the corks, commencing at the end where the cork is two inches back in the tube, and then passing it out through the hole in the other cork, and then screw on the handle, and withdraw the handle until the bulb of the electrode is in contact with the cork. The ball thus placed is to protect the surrounding parts and to concentrate the action of the current. The current to be used with the instrument just described is obtained in the following way: The patient is in position on examining table, the glass tube is introduced as a Fergeson speculum, and the bulb of electrode is pushed down to within one-sixteenth of an inch of the cervix; to this instrument is made fast the connecting cord (this is better if of large calibre) which is then attached to one pole of the

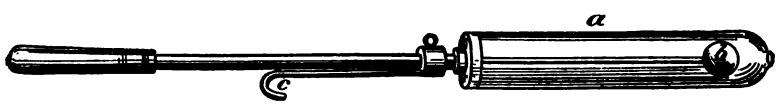


FIG. 68.—Internal Administration of Sparks. *b*, electrode; *a*, insulating tube, perforated for passage of spark and current.

machine. In the hand of the patient is placed the connecting rod of machine, or another cord, similar in size to the one above mentioned, that has been attached to the remaining pole. Having previously arranged the ends of sliding rods, representing the poles of the static machine, to within one thirty-second of an inch or so, they are barely apart, just enough to see the spark. When all is ready start the machine; a gentle, stimulating contraction is induced, bearing a close analogy to the faradic current. The faster the plates of the machine revolve—if it is a small one—the more rapid will be the discharge of sparks. These sparks can be made larger by carefully separating the poles a little more, not to exceed one-eighth of an inch; greater distance than that causes pain. A valuable and necessary adjuvant to the machine is a platform about three feet long and two feet wide, having glass or hard-rubber legs, or wooden ones resting in glass insula-

tors such as are used on telegraph poles. When the current is used externally, it is absolutely necessary for the patient to be on this platform, usually sitting on a stool. (It is better than a chair, in not having a back.) The connection in this case can be made either by the patient holding the brass connecting rod of the machine, or having the rod rest on the floor of the platform, see-

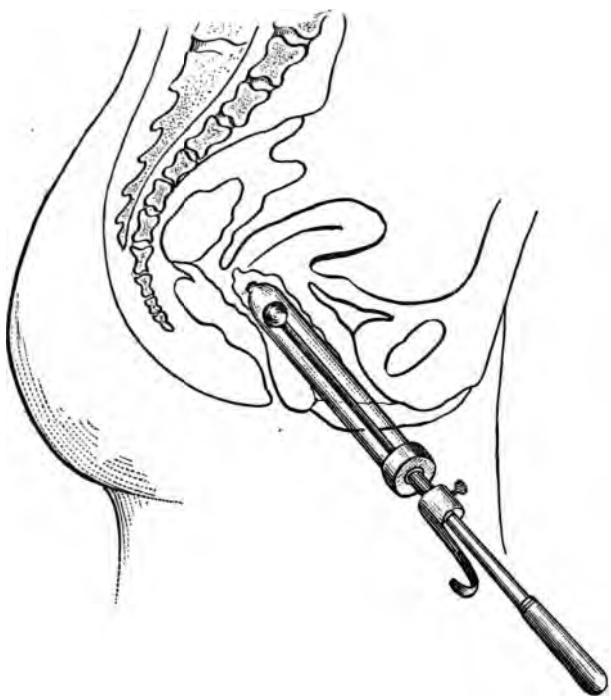


FIG. 69.—Morton's Electrode administering the Static Induced Current.

ing that the patient does not touch it with her foot; in case that should occur it would hurt and frighten the patient, particularly if the Leyden jars be connected. The instruments used in treating a patient in the way last described, on insulated platform, are known under the following names: wood ball and point electrode, spinal (brass) roller electrode, Morton's pistol electrode, and

brass disc or crown to be suspended over head within ten inches of patient. With these instruments the conditions for which static electricity is the remedy are all familiar ones, namely, hysteria and hysterical paralysis, so often seen as a reflex uterine irritation; chlorosis; pain in the back, and pain over or in the region of the ovary; migraine and menopause. The internal application of the static electricity will be found useful in amenorrhœa, subinvolution, and ovarian pain.

Duration of Application.—For sedative, soothing influences, with patient sitting on insulated platform and with head disc, the patient should take it for fifteen minutes and never for a shorter time than ten; every day, if possible, but not less, as a rule, than twice weekly.

Slight hysteria or nervousness and menopausal symptoms are amenable to this form.

If counter-irritation is needed, the treatment by spark should be used, using the brass ball or Morton's pistol electrode up and down the spine. Séance should not exceed five minutes, applied three times a week. Severe hysteria, chlorosis, and pain in the small of back—sacral—and general soreness over ovaries, are best treated in this way.

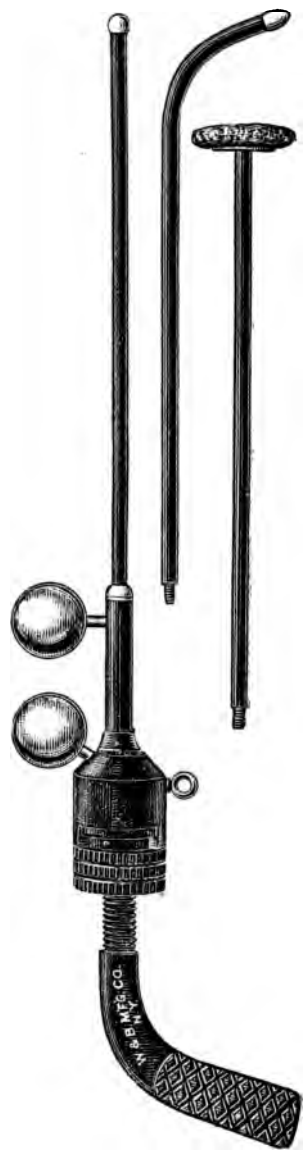


FIG. 70.—Morton's Static Universal Electrode with terminal attachments.

The internal use, gently and carefully given for the conditions previously named, should last five minutes and be made twice a week. As a rule, static electricity can be used soothingly ten to fifteen minutes.

Static electricity as developed from a Holtz machine is used in gynæcology by three methods, and this has been rendered possible through the invention of new electrodes by Wm. J. Morton, of New York. The methods are:

1. The internal use of the "spark." This is accomplished by means of his internal-spark electrode, by means of which a protected ball electrode is introduced into the vagina, and the spark is directed to any desired point—as, for instance, the cervix.

2. The internal use of the "static universal electrode," having terminals according as it may be desired to administer his franklinic interrupted current within the uterus or at any point in the neighborhood.

3. The administration of his "static" induced current in exactly the same manner as the galvanic or faradic current is now administered. This method includes, therefore, in technique the entire range of galvanic and of faradic applications.

Of these methods, the latter is to be preferred in practice as being eminently practical. The static induced current is highly analgesic and is therefore to be employed whenever it is desired to relieve pain. It stimulates both nerve and muscle, producing the familiar tetanoid condition of muscle with a minimum of pain. The effect exerted upon the muscular tissue of arteries, arterioles, veins, and lymphatics improves local nutrition, possibly, thus leading the way to, if not effecting, the absorption of exudates.

Time is as yet required to determine the exact value of Morton's appliances in gynæcology. The reputation acquired by the originator should, however, commend them to all who are anxious to progress in gynæcological electro-therapeutics.

CHAPTER V.

THE TREATMENT OF MALIGNANT GROWTHS BY THE GALVANO-CAUTERY.

In the preceding chapters we have considered electricity mainly in its chemical aspect. We now pass to that form of the agent where it is converted into heat. The force of the current is expended in heating the electrode which is applied to the tissues which we aim at affecting. The amount of heat resulting varies directly according to the resistance of the conductor and the square of the current which is transmitted. If the resistance of the current is low and the square of the current small, then the rise in temperature is almost imperceptible; but when the conditions are reversed, then, if a portion of the circuit has a high resistance, there it is that the elevation of temperature is very great. If this resisting part of the circuit be composed of metal, then it becomes incandescent. The metal selected for cautery purposes must be of such a nature that it will not oxidize when heated. Platinum is the agent which possesses in the highest degree this qualification, and therefore cautery knives and loops are constructed from it.

Cautery batteries differ necessarily greatly from those which we have considered as applicable to galvanic and faradic work. The Byrne battery and the Piffard are probably the best, and the latter is preferable to the former in that the cells are larger.

The Piffard battery consists of six platinum zinc elements. The generating fluid is the solution of bichromate of potassium. The elements, suspended in this fluid, may be moved to and fro, and thus polarization is prevented. The cells hold nearly one pint of fluid.

The battery devised by Dawson, of New York, is also to be commended, especially for its simplicity. It consists of only two cells. In each cell are two zinc (positive) plates and one platinum (negative) plate. These plates measure four and a half by six inches. The platinum plate is placed between the zincs, these latter being only one-half inch apart. On each side of the platinum plate are hard-rubber agitators, which when set in motion prevent polarization. The rapidity with which these agitators are moved causes a greater or less intensity of heat. The zincs are perforated, so that when the plates are agitated the fluid between them, which has become exhausted, passes out through the perforations and new fluid enters.

The electrodes essential for cautery purposes do not require special consideration. They consist of handles to which is attached the platinum. This platinum is arranged as a loop, as a knife, as a dome, or as a slender probe for insertion into sinuses.

The galvano-cautery in gynæcology will be considered here purely as applicable to malignant disease of the uterus. It is intended as a substitute for the knife, and its claim to consideration must rest on an analysis of the ultimate results obtainable from it and from the alternative methods by the knife—high amputation and vaginal hysterectomy. Although the time is not ripe for dogmatic statement, we may still draw an approximate conclusion from a study of the statistical data furnished by those who favor one or another method over the other.

In the class of cases we propose to consider, the malignant growth is limited, as far as may be clinically determined, to the uterus. It is in these instances alone that we may be sanguine of ultimate cure by any method of treatment. Before stating the ultimate results obtainable from resort to the galvano-cautery, we will insert, for purposes of comparison, the latest data yielded by vaginal hysterectomy and the high amputation. The statistics which we offer are purposely limited to recent

years, seeing that previously antisepsis and operative technique were imperfect.

The immediate mortality from vaginal hysterectomy is to-day as low as five out of one hundred in the hands of recognized expert operators. Of individual operators, Leopold furnishes a series of eighty with four deaths; Kaltenbach a series of fifty-three (cancer of the cervix) with two deaths; Ott a series of thirty cases without a death, and Péan of twenty-five consecutive successful cases. American operators have not as yet been able to equal, in respect to immediate mortality, the results obtainable abroad.

The ultimate results from vaginal hysterectomy—that is to say, the data as regards recurrence—are not specially encouraging. The following table, furnished by Martin, gives the results obtained by a number of German operators:

Recurrence at the end of	Leopold, 56 cases.	Schröder, 62 cases.	Fritsch, 55 cases.	Martin, 56 cases.
1 year.....	16	20	17	35
1½ years.....	9	10	..	32
2 years.....	5	7	7	25
3 "	2	4	2	20
4 "	..	..	..	5
5 "	..	..	..	3
6 "	..	..	..	2

Or, in percentages:

Recurrence at end of 1 year..... 42.3 per cent.
" " " " 1½ years.... 32.9 " "
" " " " 2 " .... 21.15 " "
" " " " 3 " .... 13.4 " "
" " " " 4 " .... 2.4 " "

French statistics offer the following results: In Bouilly's twenty-nine cases, recurrence in less than a year in thirteen; of Richelot's twenty-four cases there were eight rapid recurrences—that is to say, in less than a year.

Hofmeier considers non-recurrence at the end of two years as a sign of complete cure, and from an analysis of Schröder's cases he concludes that the percentage of cures may be placed at twenty-four per cent.

The results furnished by high amputation—an operation the sphere of which is limited strictly to cases where the disease has not extended above the internal os—are, approximately, as follows: From Schröder's clinic, of one hundred and five partial extirpations there were ten deaths, and the result after two years was forty-six cures out of one hundred. Baker, of Boston, has reported ten cases without a death, and his ultimate results are: recurrence in two cases after a few months, one cure for two years and then recurrence, one cure for four years, one for four years and seven months, one for five years, one for five years and three months, two for six years, one for eight years and then recurrence. Reamy's results in fifty-seven cases are: two immediate deaths, in twenty-nine cases recurrence in from one to fourteen years, the remaining twenty-six were cured.

From the above brief analysis it would seem as though, for the present, high amputation—the case being suitable—were preferable to vaginal hysterectomy, the latter operation being reserved for instances where the disease affects and is limited to the body of the uterus.

To pass now to the results obtainable from the galvano-cautery, our data are necessarily derivable from the reported work in this line of Byrne, of Brooklyn. For over one-quarter of a century his custom has been to treat cancer of the uterus by this means, and his experience is, therefore, superior to that of any other surgeon.

Byrne's experience is derived from three hundred and sixty-seven patients treated by the galvano-cautery. In every instance the disease was unquestionably cancer. Of the entire number forty-five per cent were lost sight of, and are therefore not utilized in the estimation of ultimate results. In his method he is particular in laying stress on the absolute necessity of thoroughly cauterizing

the surface and the edges of the tissue from which the cancer has been removed. This is *the* step which constitutes the best safeguard against recurrence of the disease. Baker also lays stress on this point. He uses, however, the Paquelin cautery instead of the galvano.

Of Byrne's three hundred and sixty-seven cases the disease was limited to (1) the portio vaginalis in fifty-nine cases; (2) the entire cervix in eighty-one cases; (3) the corpus uteri in eight cases; (4) both body and cervix in two hundred and nineteen cases.

The comparative statistics in each class are: In Class 1 an average period of exemption of eight years and seven months, thirty-six cases being utilized; in Class 2, average minimum period of exemption, thirty-five cases being utilized, of five years and nearly six months; in Class 3 the average period of relief from hæmorrhage, pain, and discharge is, in four cases, two years; in Class 4 the average respite from pain, hæmorrhage, and discharge, in seventy-eight cases, was within a fraction of three years.

Byrne's method of operating where the cervix alone is affected is simply to amputate, by the heated loop or knife, at or above the vaginal junction. The stump is next thoroughly recauterized.

Where the disease has extended beyond the cervix his method is the following: The cervical canal is thoroughly curetted, and next, the uterus being artificially prolapsed by a double tenaculum inserted within it, the vaginal attachments are severed by the platinum knife. The galvanic loop is next adjusted as high as possible and the diseased portion removed. The mucous membrane of the cavity is then thoroughly seared to the depth of at least one-half an inch, and the stump is finally thoroughly recauterized. Where the disease affects the body of the uterus the curette is first used, and then the cavity is thoroughly seared.

By means of the galvano-cautery Byrne has obtained better results than those yielded by any other method of treatment. His immediate mortality is *nil*, and his sta-

tistics as regards recurrence cannot be equalled. Strange to say, however, the method is hardly utilized at all by others. It stands as a method which should appeal strongly to the surgeon in the face of malignant disease, and possibly it will be resorted to with greater frequency if the statistics of the future from the knife do not furnish more favorable data as regards cure.

CHAPTER VI.

ELECTRICITY IN OBSTETRICS.

ELECTRICITY has never been utilized in obstetrics to the extent to which *a priori* it would seem to be entitled. In treatises on the art reference is here and there made to its value, but the impression ordinarily given to the reader is that, however useful the agent might be, there is rarely an opportunity to prove this, seeing that the apparatus is not at hand when needed. A glance through the literature of the past few years, however, should serve to prove the advisability of the obstetrician having the agent ever at his disposal, for the multiplied experience of individual observers certifies to the fact that in certain of the complications of labor electricity ought to appear as an adjuvant far more frequently than it ever has. Seeing that the current which it is usually desirable to use is the faradic, the chief objection hitherto brought against it, that the agent is not at hand when needed, does not hold, for there are a number of induction machines to be obtained to-day which are so small and compact as to be readily carried in the ordinary obstetrical bag. The Gaiffe and its modifications occupy but little space and may be very speedily set in action. A very convenient instrument is the Stanley faradic battery, since it is so readily handled without the annoyance of spilling the fluid. The current may be applied either with one electrode against the cervix and the other over the abdomen or sacrum, or else with one electrode over the abdomen and the other over the sacrum. Baird, of Texas, who is an earnest advocate of the use of electricity in obstetrics, has found the following method ad-

vantageous: A copper plate one and one-quarter inches wide and five inches long, covered with a wet napkin, is placed over the sacro-lumbar region and connected with the rheophore which belongs to the positive pole. The rheophore from the negative pole is attached to a wrist electrode worn by the accoucheur, so that by means of his hand, which closes the circuit over the patient's abdomen, he is able to note the effect of the current on the uterus. The current may further be utilized by inserting one electrode into the rectum—a method which is peculiarly applicable to ectopic gestation.

The bipolar intra-uterine electrode will also prove most serviceable, in particular where it is of importance to cause the uterus to contract rapidly. This electrode may readily be rendered aseptic, and is so small that it occupies but little additional space in the obstetrician's satchel.

In resorting to electricity during labor, it may be generally stated that it is advisable to use a mild current and to take the precaution not to pass the current through both poles of the fœtal ovoid. The applications should be intermittent, even as are the normal uterine contractions. The current thus applied cannot be considered dangerous either to the mother or the fœtus, and it will usually evoke or reinforce contractions. After the completion of the third stage of labor, in the presence of uterine inertia the conditions are, of course, different. It is then advisable to utilize the full strength of the current, within, obviously, the limits of tolerance. The current from the thick wire coil—the quantity current—should always be selected, seeing that this is the current which chiefly causes contraction of muscular fibre and maintains it. This is a point too frequently overlooked in practice, and therefore the disappointment which often follows the application of electricity in the emergencies of the lying-in room. In this connection, however, even as elsewhere throughout this treatise, electricity is spoken of as an adjuvant to routine methods.

Having already referred at length to the value of electricity in ectopic gestation, it remains only to speak of it as an oxytocic.

ELECTRICITY AS AN OXYTOCIC.

In this connection electricity is considered as an agent for reinforcing or awakening uterine contractions. We are justified in taking for granted the acceptance of the statement that electricity is able to cause contractions of the uterus, either indirectly through the effect of the current on the nerve centres which innervate the organ, or else directly through stimulation of its muscular substance. On this point there seems to be no scope for difference of opinion. The question to be settled, tersely stated, is this: Has electricity any advantages over the routine methods at our disposal in those conditions in which stimulation is called for? If it has not, then it is scarcely worth the obstetrician's while to burden himself with an additional instrument; if it has, then, in view of the fact that in certain emergencies even the most reliable means may fail, any number of additional ones should be welcomed.

It would be a thankless task to burden these pages with a record of the diverse opinions which have been expressed in regard to the utility of electricity as a means of stimulating the uterus to contraction or of restoring tone to it when its energies are flagging. We will consider the subject rather from its clinical than its theoretical side, in connection with the two conditions in which electricity may *a priori* claim to be indicated, and particularly in comparison with those measures which are matters of accepted routine.

The two conditions in which we are called on to reinforce or awaken uterine contractions are uterine inertia and the induction of premature labor.

Uterine Inertia.—This condition, broadly speaking, may be present during either of the three stages of labor, or may follow at a variable interval on the completion of

the third stage. We will briefly consider the cause of the inertia during these separate periods, and thus endeavor to deduce the indication, if it exist, for resort to electricity.

During the first stage of labor, under the usual normal conditions—that is to say, given a parturient canal of sufficient size, a fœtus presenting favorably, and the absence of pathological alterations in the soft parts—a prime cause of ineffective uterine contractions is exhaustion of the parturient. What is needed here, then, is rest for the uterus rather than stimulation. In this stage, therefore, resort to electricity will as rarely be called for as, in the opinion of leading obstetricians, are other oxytocics, such as massage and ergot. In this stage, while the labor is otherwise progressing normally, time and patience will be of greater advantage to both the mother and the child than resort to any uterine stimulant. In the second stage of labor the conditions are somewhat different. Dilatation of the cervix once completed, it may be considered of positive advantage to end the labor as soon as possible without resort to means which are meddlesome or fraught with danger to either the mother or the child. Here, then, stimulation of the uterus and of the abdominal muscles, while of direct assistance to the parturient, is not at all open to the charge of interfering with the natural forces, but, on the contrary, may be looked upon as a desideratum. At this juncture, then, we may properly consider the value of electricity in comparison with other means of assisting the mother. Resort to ergot is common enough still during the second stage, notwithstanding the fact that prominent obstetricians reject the drug prior to the completion of the third stage of labor. Unquestionably ergot will reinforce the contractions, and will not always by any means be attended by those tetanic contractions which imperil the life of the child, or, after its birth, may interfere with the due completion of the third stage of labor. In view, however, of these possible consequences, it seems wiser

to reject ergot in the second stage. Massage and compression of the uterus are further means, and, in general, effective ones, of reinforcing the contractions during the stage of expulsion. The method by massage and compression, however, is tedious, and the compression, if persisted in, becomes annoying to the patient. Electricity, on the other hand, is not open to the objections which attend the use of ergot. None of those who have used it, as far as we have been able to discover, have found that the agent tetanizes the uterus; and so far from the patient complaining of the applications, she will often crave them, for exceptionally it seems as though they took the edge off the pain. This latter point is one on which Baird lays considerable stress, although we have personally not noted this sedative effect, nor does it seem to have especially impressed other observers. This gentleman states that "whenever the pains are of sufficient severity to cause considerable distress, I make *them a pretext* for the use of the faradic current, at the same time promising the patient *some* relief from her sufferings, but without explaining to her or her friends all the benefit which I expect her to derive from its use. In making the application to relieve pain I pay no regard to the stage of the labor. Too much care cannot be exercised here, in making the application to the abdomen, not to use too small an electrode," else, the current being localized, painful contractions of the abdominal muscles are at once produced. "At first a current barely strong enough to be perceptible to the patient is generally sufficient, and it can be gradually increased if necessary. I then keep the circuit closed until sedation is obtained." It seems likely, then, that in addition to reinforcing the expulsory pains through resort to electricity, we may spare the patient suffering—an advantage which no other oxytocic means at our disposal possesses.

During the second stage electricity has, over and over again, rendered us valuable service. A marked case in

point is the following, occurring in Grandin's practice: He was called in consultation to see a woman in labor with her first child. The second stage was thoroughly completed and had not lasted longer than the average. The patient was not exhausted, she was having pains, but, although careful examination failed to reveal either pelvic contraction or abnormal presentation, the patient could not deliver herself. The head of the fœtus having engaged, version was contra-indicated. Instead of applying the forceps, with possible resultant injury to mother or child, Grandin determined to test electricity, although the attending physician expressed his utter lack of faith in the agent. One pole of a Stanley battery was given to the patient; the other was held in one hand of the accoucheur, while the abdomen was massaged by the other hand. In a few minutes the uterine contractions became energetic, and in about fifteen minutes the fœtal head was on the perineum, whence it was readily delivered by the forceps.

During the third stage of labor electricity will not often find a place. When the uterus is given time, as it should be, to rest and recover tone after its efforts, under normal conditions judicious expression is all that is needed to complete the stage; and so long as there are no indications —the chief of which is hæmorrhage—for active spurring of the organ, it is a sound rule to leave it alone, that the placenta may have the opportunity to separate normally. In the event of inertia and hæmorrhage during this third stage, the faradic current will very likely evoke contractions, but the preferable indication then is to proceed to the manual removal of the after-birth, a step which of itself will often cause uterine contractions. If it should not, the placenta having been removed, we are in the presence of inertia after the completion of the third stage—that is to say, post-partum hæmorrhage is either a fact or is imminent, and in this complication electricity must take high rank as an adjuvant in treatment. It cannot, however, be depended upon alone, to the exclusion of other

recognized methods; for the fact must be emphasized that, although occasionally the uterus responds instantaneously, as it were, to the faradic stimulus, in other instances the action is too slow to meet the emergency, and in others still it may fail altogether. Often, again, where the uterus contracts under the influence of faradism, it relaxes at once when the circuit is broken. The agent, hence, is one not to be depended on in this emergency, except in conjunction with other well-known means. It is here that the bipolar intra-uterine electrode will prove of positive value. If it be connected with the coarse wire coil and inserted to the fundus, the uterus will be caused to contract most energetically, and these contractions will be maintained whilst awaiting the action on the uterus of ergot given hypodermatically. In a case recently seen by Grandin, where the uterus was in such an atonic condition that its cavity and that of the vagina formed but one, bipolar faradization caused immediate contraction and thus checked the hæmorrhage which was seriously endangering the patient.

To summarize, then, the facts in regard to the value of electricity during labor, as they present themselves to us from a careful study of the contributions to the subject: The agent may be considered a valuable aid to the parturient during the second stage, in that by means of it we are able to assist the expulsory forces, and there is reason, further, to believe that a certain amount of sedation is exerted; during the first and the third stages of labor there are means at our disposal for assisting the parturient which better fulfil the indications—that is to say, rest during the first stage, expression during the third stage; after completion of the third stage, in the presence of more or less inertia, electricity may be looked upon as a decided adjuvant to the routine methods at our disposal, but it cannot be depended upon alone to avert an impending or to check an existing hæmorrhage.

It is but just to state that in reaching these conclusions

we have endeavored to draw a happy mean between those observers who are enthusiastic in regard to the value of electricity in labor and those who can see no good in it. The diversity of opinion is very striking among practical obstetricians. Thus, to refer only to the views advanced of later years, Playfair, in discussing Kilner's paper on the induced current during parturition, said that he had tested the current and it had proved a failure, possibly because he lacked the special skill, and that if special skill were needed it could not be generally used. He had found its effects in diminishing pain slight, and not to be compared with other means at our disposal. He considered it useless as an oxytocic. On the other hand, Murray, of New York, has treated over fifty cases of uterine inertia by means of the faradic current and with uniformly good results; Tripier and Apostoli are strong advocates of faradization; Robert Barnes states that by means of electricity the uterus can be made to contract when it resists the influence of what may be called "diastaltic remedies," although he cannot rely on the agent in that its effects are not always permanent—an objection which is applicable with peculiar force to its utility in case of post-partum hæmorrhage; Lusk says that "probably the faradic current is a most efficient agent in securing contractions of the uterus," but then it is rarely on hand when needed; finally, Baird, who has used electricity in obstetrics to a greater extent than any one in this country, claims that the agent "stands unrivalled as an oxytocic." In his hands it has subserved the following purposes: 1. To modify the pains of labor. 2. To favor a more rapid dilatation of the os. 3. To promote more vigorous uterine contractions. 4. To add tone and strength to all the muscles engaged, and increase their power of doing work. 5. To abridge the time occupied by the labor. 6. To prevent shock, exhaustion, and post-partum hæmorrhage. 6. To insure contractions of the uterus in cases of instrumental delivery. 8. To arrest hæmorrhage and accelerate

labor in cases of placenta prævia. 9. To prevent an undue expenditure of nervous force in all cases of debility from whatever cause, thus leaving the patient in a condition to secure a speedy and favorable convalescence.

The chief reason why most observers have been disappointed in electricity is that they have not, with few exceptions, used it properly. As we have stated, the results to be obtained are through the bipolar electrode connected with the coarse wire coil. When this fact is recognized a greater measure of success will attend resort to the agent.

The Induction of Premature Labor.—In our systematic treatises on obstetrics electricity is hardly recognized as an agent deserving of serious consideration among the means to be resorted to for the purpose of inducing labor. Lusk, for instance, classes it among the methods which are not entitled to anything more than mention as having been suggested; Schroeder ranks it with the agents which have only a historical value; Playfair says that it is a means too uncertain to be relied upon, and that it is irksome both to the patient and the practitioner; Barnes, after testing it in three cases, while he succeeded in inducing labor, found the method tedious and sometimes distressing to the patient. Notwithstanding these views, a number of instances have of late years been reported which seem to speak quite strongly in favor of this method of inducing labor. Bayer, from his experience in eight cases, claims that electricity is the best, safest, and most certain means of inducing labor; and Baird records a number of instances where the agent was of unquestionable value, although he used it in connection with local dilating measures. The most recent writer on this subject is Brühl, who reports in detail seven cases in which the value of electricity was carefully tested. He used, as also Bayer, the constant current, and these cases may be taken as typical of what may be expected from resort to galvanism. His conclusions are, and the

record justifies them, that, while the method does not carry with it special risk to the mother or the fœtus, its effects are uncertain, and if the applications be persisted in the uterus may be rendered so irritable as not to respond readily to other means of inducing labor in case it becomes requisite to resort to them. In not one of the instances he reports was galvanism alone effective; in three it failed altogether; in four contractions were evoked and the cervix partly dilated, but these contractions had to be reinforced by other means. It is to be noted, further, that galvanization was repeated from two to twenty-four times, and that from five to twenty-eight days were required, even in connection with other means, to attain the desired end. The length of time and the number of applications requisite were about the same in the cases reported by Bayer. We may fairly, hence, conclude that galvanism is hardly entitled to consideration among the means for inducing labor, since not uncommonly, where interference of this nature is called for, the welfare of the patient is opposed to the waiting which this current necessitates. In regard to faradism, when used alone, the same general conclusion is warrantable. Owing to its acknowledged greater power of inducing muscular contractions, the time requisite for starting labor by means of it is likely to be considerably shorter than that demanded by galvanism. But the point to be emphasized is that although contractions of the uterus may be evoked, they are very likely to die away as soon as the stimulus is withdrawn, and to maintain them some adjuvant means must be utilized. This is precisely what Baird did in the instances he has recorded. He faradized the uterus, and at the same time dilated the cervix by his finger and Barnes' bags, and was thus enabled in seven cases to induce labor in less than ten minutes. It is at once apparent that the combination of these two means has advantages over any recognized method used alone, and herein would seem to lie the reason why electricity, in the faradic form, may

be classed among the means suitable for inducing premature labor. It is assuredly entitled to further tests, for, although the ultimate result may only be its estimation as an adjuvant, as such there is ample scope for it in an emergency where on speedy result the welfare of the mother and of the fœtus not infrequently depends.

ELECTRICITY IN CASE OF RETAINED SECUNDINES AFTER ABORTION.

This method has been proposed by Henry D. Fry, of Washington. Our own experience with it has been *nil*, being amply satisfied with the curette, for which the method is intended as a substitute.

The method is suggested as rather applicable to instances of remote retention of the secundines—that is to say, where, a few months after delivery, hæmorrhage occurs; and this is presumably due to the presence in the uterine cavity of portions of the membranes or of placenta. Fry's argument is based on the consideration that electricity acts most energetically upon those tissues which possess the least power of resistance—that is, the least vitality; it consequently promotes the exfoliation and expulsion of the decidual membrane or retained placental tissue. This enfeebled vitality, Fry continues, is the key to the value of electricity. This agent destroys the slight claim to existence of the retained secundines. Further, the action of electricity is limited. If the curette be used, on the contrary, the effect of the scraping is also on sound tissue.

The galvanic current is preferred over the faradic. The anode is selected as the active pole for intra-uterine application, for the reason that the object is to secure a local effect and not to produce absorption. The electrode is guided as nearly as possible to the part of the uterus where the retained remnant is supposed to be. Any hæmorrhage which may result from the insertion of the electrode or the separation of the remnant is at once checked, seeing that the positive has been selected

as the active pole. Further, this pole being antiseptic in its effect, risk of sepsis following the procedure is reduced to a minimum.

In exemplification of the utility of this method we append the following case reported by Fry:

Mrs. X., when three months pregnant, had a miscarriage. The ovum passed intact, except that from one side the chorion was missing, the velvety appearance being absent over the corresponding surface.

The cervix contracted, the uterine flow was natural, and the patient made a satisfactory recovery. Contrary to my conviction of what is the proper treatment for such cases, the decidual membrane was not forcibly removed. She was kept under observation for some months, and, as no symptoms occurred to point to the contrary, I led myself to believe that the uterine contents had been evacuated in the usual manner when left to nature.

One year elapsed, when I was called again to see this patient on account of menorrhagia. I then learned that the menstrual flow had reappeared two months after the miscarriage; it had recurred monthly, and had been normal, in every respect, for six months. Then missing two months, it had come on profusely and lasted two weeks; missing another period, she next had a free and continuous flow, which lasted four weeks in spite of appropriate treatment—until, in fact, electricity was employed. Rest in bed, tampons, hot vaginal douches, the administration of astringents and of hydrastis canadensis, having failed, the curette was used and some shreds of membrane removed, which, on microscopical examination, proved to be pieces of chorionic membrane.

Hæmorrhage continuing, the galvanic current was applied two days afterwards. The dispersing electrode, which consisted of a copper gauze, ten by seven inches, covered with absorbent cotton, was placed upon the abdomen and connected with the negative pole of the battery. The positive pole, a platinum sound, was passed

to the fundus uteri, and the portion extending from the os externum to the handle was insulated with a tubing to protect the vaginal walls. The current was slowly increased, and sixty milliampères were passed for eight minutes.

In a similar manner three more applications were made on alternate days, and seventy, eighty, and ninety milliampères passed at the respective sittings, the duration of each séance being from six to ten minutes.

Result: The hæmorrhage was decidedly lessened after the first application. The tampons were dispensed with, and the patient sat up in bed without increasing the flow. Bleeding decreased steadily after the second and third sittings, and ceased after the fourth. On the day succeeding the third application a piece of membrane was passed. Unfortunately it was not kept, but was described by the patient as looking like "gristle." On the next day, while introducing the speculum preparatory to making the fourth application, a piece of membrane, three-quarters by one-third inch, was found in the vagina, together with several smaller pieces. These, under the microscope, proved to be decidual membrane.

The hæmorrhage, as I have said, stopped and no membrane came away after the fourth application. The patient has remained well since removal of the secundines, the menstruation is normal, and the uterus is steadily decreasing in size under the use of the faradic current and galvano-puncture of the cervix.

This method is certainly worth testing. Its disadvantage is that it requires more time than the curette, but an advantage is that it does not necessitate anæsthesia, as is so frequently the case where cervical dilatation must precede the insertion of the curette.

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